TRANSACTIONS AND PROCEEDINGS

OF THE

BOTANICAL SOCIETY OF EDINBURGH.

TRANSACTIONS AND PROCEEDINGS

OF THE

BOTANICAL SOCIETY OF EDINBURGH.

VOLUME XXVII.

INCLUDING SESSIONS LXXX.-LXXXIII.

(1915-1919).

WITH NUMEROUS ILLUSTRATIONS.

EDINBURGH:

PRINTED FOR THE BOTANICAL SOCIETY,

1919.

CONTENTS OF VOL. XXVII.

	PAGE
Proceedings for Session 1915–1916	i
Do. do. 1916–1917	vii
Do. do. 1917–1918	xi
Do. do. 1918–1919	xv
Some Plant Associations of N.W. Yunnan. By F. Kingdon Ward, B.A., F.R.G.S.	1
On the Sino-Himalayan Flora. By F. Kingdon Ward, B.A., F.R.G.S.	13
Notes on the Flora of the Orkney Isles. By Arthur Bennett, A.L.S.	54
Periodicity in Transpiration. By Sophie J. Wilkie, B.Sc. (Two Figures)	59
Saxifrages of the Diptera Section, with Description of New Species. By Professor Bayley Balfour, F.R.S.	65
The Influence of Different Media on the Histology of Roots. By Sophie J. Wilkie, B.Sc. (Plate I)	76
Rhododendron trichocladum, Franch., and its Allies. By Professor Bayley Balfour, F.R.S.	79
New Garden Dracocephalums from China. By W. W. Smith, M.A., and George Forrest	89
Note on *Parasyringa*, a New Genus of Oleaceae. By W. W. Smith, M.A.	93
Rhododendron lacteum, Franch. By Professor Bayley Balfour, F.R.S.	97
A Hybrid Potamogeton new to the British Isles. By Arthur Bennett, A.L.S.	104
On the Affinities of *Sedum Praegerianum*, W. W. Sm., with a Tentative Classification of the Section Rhodiola. By R. Lloyd Praeger, B.A. (Plates II–IV)	107
Cavea: A New Genus of the *Compositae* from the East Himalaya. By W. W. Smith, M.A., and James Small, M.Sc. (Plate V)	119
Mosses of West Lothian (V.C. 84). By J. C. Adam	123
Ceratophyllum demersum, Linn., in the Orkney Isles. By Arthur Bennett, A.L.S.	134
Ulex nanus, Forst., in Caithness. By Arthur Bennett, A.L.S. .	135
Note on Insect Visitors to *Corallorhiza innata* and some other Orchids in the Forth District. By William Evans, F.R.S.E.	136

PAGE

Some Moss Records for Selkirk, Peebles, and the Lothians. By William Evans, F.R.S.E. 138

Rhododendrons of the Irroratum Series. By Professor Bayley Balfour, F.R.S. 157

Observations on Rhododendron Seedlings. By Professor Bayley Balfour, F.R.S. 221

Bulbophyllum Imogeniae, a New Orchid from Nigeria. By Kenneth Hamilton 228

Some New Species of Primula which have Flowered Recently. By Professor Bayley Balfour, F.R.S. 231

Some Late-flowering Gentians. By Professor Bayley Balfour, F.R.S. 246

The Genus *Nomocharis*. By Professor Bayley Balfour, F.R.S. . 273

Note on the Occurrence of *Clathrus cancellatus*, Tournf., in Argyllshire. By the Very Rev. Dr. David Paul. (Plate VI) 301

Koeleria advena, Stapf, sp. nov. By James Fraser . . 302

Calamagrostis stricta and *C. strigosa*. By A. Bennett, A.L.S. . 305

Notes on the Flora of Caithness. By A. Bennett, A.L.S. . . 309

Potamogeton longifolius, Gay, in England. By Arthur Bennett, A.L.S. 312

Notes on Dr. Hagstrom's "Critical Researches on Potamogeton, 1916." By Arthur Bennett, A.L.S. . . 315

Notes from Cannock Chase on *Vaccinium intermedium*, Ruthe. By Captain W. Balfour Gourlay, M.C., R.A.M.C. . . 327

Scottish Records of *Myelophilus* (*Hylurgus*) minor (Hartig). By R. Stewart MacDougall, M.A., D.Sc 334

The Preservation of Artificial Cultures of Moulds. By Harry F Tagg, F.L.S. 335

Whytockia, a New Genus of Gesneraceae. By W. W. Smith, M.A. (Plate VII) 338

OBITUARIES: William Watson, M.D. 339
Robert Chapman Davie 342
William Brack Boyd 344

APPENDIX 347

INDEX 356

PROCEEDINGS

OF THE

BOTANICAL SOCIETY OF EDINBURGH.

SESSION LXXX

OCTOBER 14, 1915.

R. A. ROBERTSON, M.A. B.Sc, President, in the Chair.

The following gentlemen were elected Office-Bearers for the Session:—

PRESIDENT.

R. A. ROBERTSON, M.A. B.Sc.

VICE-PRESIDENTS.

ALEXANDER COWAN, Esq.
JAMES FRASER, Esq.
SYMINGTON GRIEVE, Esq.
JAMES WHYTOCK, Esq.

COUNCILLORS.

A. W. BORTHWICK, D.Sc.
Sir ARCHIBALD BUCHAN-HEPBURN, Bart.
T. BENNET CLARK, C.A.
R. C. DAVIE, M.A., D.Sc.
JAMES GRIEVE, Esq.
J. RUTHERFORD HILL, Esq.
R. STEWART MACDOUGALL, M.A., D.Sc.
HARRY SANDERSON, Esq.
W. G. SMITH, Ph.D., B.Sc.
MALCOLM WILSON, D.Sc., F.L.S.

Honorary Secretary—W. W. SMITH, M.A.
Curator of Herbarium—W. CALDWELL CRAWFORD, M.A., F.R.S.E.
Foreign Secretary—Rev. D. PAUL, M.A., LL.D.
Treasurer—RICHARD BROWN, C.A., 23 St Andrew Square.
Assistant-Secretary—J. T. JOHNSTONE, M.A., B.Sc.
Artist—Professor FRANCIS M. CAIRD, M.B., C.M., F.R.C.S.E.
Auditor—ROBERT C. MILLAR, C.A.

LOCAL SECRETARIES.

Aberdeen—Professor J. W. H. TRAIL, M.A., M.D., F.R.S., F.L.S.
Bathgate—ROBERT KIRK, M.D., F.R.C.S.E.
Berwick-on-Tweed—FRANCIS M. NORMAN, R.N.
Birmingham—W. H. WILKINSON, F.L.S., F.R.M.S., Manor Hill, Sutton Coldfield.
Calcutta—Professor S. C. MAHALANOBIS, B.Sc., F.R.S.E., F.R.M.S., Presidency College.
Cambridge—ARTHUR EVANS, M.A.
Croydon—A. BENNETT, A.L.S.
Dundee—Professor P. GEDDES, F.R.S.E.
East Liss, Hants—JAMES SYKES GAMBLE, M.A., C.I.E., F.R.S.
Glasgow—Professor F. O. BOWER, Sc.D., F.R.S, F.L.S.
London—WILLIAM CARRUTHERS, F.R.S., F.L.S.
„ J. F. DUTHIE, B.A., F.L.S.
„ E. M. HOLMES, F.L.S., F.R.H.S.
„ Lieut.-Col. Sir DAVID PRAIN, M.D., C.I.E., F.R.S., F.L.S., Royal Botanic Gardens, Kew.
Melrose—W. B. BOYD, of Faldonside.
Philadelphia, U.S.A.—Professor JOHN M. MACFARLANE, D.Sc., F.R.S.E.
St Andrews—Professor M'INTOSH, M.D., LL.D., F.R.S.E.
„ ROBERT A. ROBERTSON, M.A, B.Sc
„ J. H. WILSON, D.Sc., F.R.S.E.
Toronto, Ontario—The Hon. W. R. RIDDELL, B.Sc., B.A.
„ Professor RAMSAY WRIGHT, M.A., B.Sc.
Vancouver—M'TAGGART COWAN, Esq.

Miss S. J. WILKIE read a paper on Periodicity in Transpiration (see p. 59).

Miss WILKIE also communicated a note on the Influence of Different Media on the Histology of Roots (see p. 76).

A note on the Histology of Gymnosperm Cuttings was read on behalf of Miss F. B. SCOTT. (*To appear in next issue.*)

Dr. R. S. MACDOUGALL showed three specimens of a very large beetle from Sierra Leone, with a piece of stem of the cashew-nut girdled by the beetle. This beetle fells young *Eucalypti*.

Dr. MacDougall recorded, on behalf of Mr. J. LYFORD PIKE, the occurrence of the giant wood-wasp (*Sirex gigas*, Linn.) in Douglas Fir logs and in Japanese Larch. This is a new enemy of Douglas Fir.

Dr. MACDOUGALL also exhibited *Megastigmus strobilobius*, Ratz., an enemy of Silver Fir seed. The insect was bred

from seed in which the larvæ were discovered by Mr. J. M. Murray. This is the first recorded case of this enemy in Scotland.

Mr. JAMES FRASER exhibited two Fumarias from West Lothian, new records for the county: *Fumaria purpurea*, Pugsley, and *F. Bastardi*, Bor.

Mr. W. W. SMITH showed some new species lately obtained from Western China. These included *Beesia*, a new Ranunculaceous genus, a new *Syringa*, three new species of *Buddleia*, a *Roscoea*, and an *Abelia*.

Mr. W. B. BOYD sent for exhibition a branch of *Abies magnifica*, A. Murr., attacked by *Chermes piceae*.

DECEMBER 9, 1915.

JAS. WHYTOCK, Esq., Vice-President, in the Chair.

The TREASURER, Mr. RICHARD BROWN, C.A., submitted the following Statement of Accounts for the Session 1914–1915:—

INCOME.

Annual Subscriptions for 1914–1915	£34	15	0
Do. Arrears	1	10	0
Transfer from Life Members' Fund	8	10	1
Transactions sold	5	0	0
Subscriptions to Illustration Fund	10	0	6
Interest on Deposits in Bank	3	9	10
Excess of Expenditure over Income	21	3	2
	£84	8	7

EXPENDITURE.

Printing *Transactions* for 1914–15	£57	18	6
Printing Notices for Meetings, etc.	10	15	10
Rooms for Meetings and Tea	7	18	4
Hire of Lantern	1	4	0
Stationery, Postages, Carriages, etc.	2	7	9
Fire Insurance on Books, etc.	0	5	0
Honorarium to Acting Secretary	4	0	0
	£84	8	7

State of Funds.

Life Members' Fund.

Balance of Fund at close of Session 1913–1914			£101 11 1
Add—Life compositions received			13 13 0
			£115 4 1
Deduct—Transferred to Income			8 10 1
Balance as at close of Session			£106 14 0

Ordinary Fund.

Balance of Fund at close of Session 1913–1914	£36 8 11	
Deduct—Decrease during Session 1914–1915	21 3 2	
Balance as at close of Session		15 5 9
Total Funds		£121 19 9
Being—Sum in Current Account with Union Bank of Scotland Ltd.	£1 3 10	
Sum in Deposit Receipt with do.	120 0 0	
Due by Treasurer	0 15 11	
As above		£121 19 9

Note.—Subscriptions in arrear, considered recoverable: 1912–13, 15s.; 1913–14, £1, 10s.; 1914–15, £5, 10s.

EDINBURGH, *24th November* 1915.—I hereby certify that I have audited the Accounts of the Treasurer of the Botanical Society of Edinburgh for Session 1914–1915, and have found them correct. I have also checked the foregoing Abstract, and find it correct.

ROBT. C. MILLAR, C.A., *Auditor.*

Miss ELSIE CADMAN, Mr R. M. ADAM, and Mr W. G. CRAIB were elected Resident Fellows.

Dr. W. G. SMITH gave a communication on the Vegetation of Ben Ledi and illustrated his paper with exhibition of models of the regions of vegetation on Ben Ledi and Ben Lawers.

A paper on the Flora of the Orkney Isles was read on behalf of Mr. ARTHUR BENNETT (see p. 54).

Three volumes of coloured illustrations of South African Plants were exhibited on behalf of Mrs. M. CROSSMAN.

Dr R. C. DAVIE showed specimens of *Melampsora Orchidi-repentis* (Plow.), Kleb., on *Goodyera repens*, Br.

Dr. R. S. MacDougall had two exhibits showing the work of boring beetles—*Trypodendron domesticum*, Er., on Birch and *Argyresthia atmariella*, Banks, on Larch.

FEBRUARY 10, 1916.

Jas. Whytock, Esq., Vice-President, in the Chair.

Mr. F. Kingdon Ward communicated a paper dealing with Plant Associations in N.W. Yunnan (see p. 1).

Mr. Kingdon Ward communicated a further and more detailed paper on the Sino-Himalayan Flora (see p. 13).

Dr. W. G. Smith gave an account of observations on *Calluna vulgaris*, Salisb. There were included observations on the development of new shoots, on the effects of grazing, on seed-dispersal, and on the various methods of burning heather.

Mr. J. C. Adam read a paper giving new records of Mosses for Peebles-shire and West Lothian.

Dr. R. S. MacDougall exhibited specimens of trunk of Ash with the brood-galleries of *Hylesinus crenatus*, Fabr.

Dr. R. S. MacDougall also had an exhibit of Narcissus bulbs with larvæ of *Merodon equestris*.

Mr. W. W. Smith showed specimens of *Parasyringa*, a new genus of the *Oleaceae*, from the Chinese province of Yunnan (see p. 93).

APRIL 13, 1916.

Jas. Whytock, Esq., Vice-President, in the Chair.

Miss Beatrice Campbell M'Pherson was elected a Resident Fellow.

Mr. Charles Nicholson was elected a non-Resident Fellow.

Professor BAYLEY BALFOUR communicated a paper on *Rhododendron trichocladum*, Franch., and its Allies (see p. 79).

Professor BAYLEY BALFOUR also communicated a paper on *Rhododendron lacteum*, Franch. (see p. 97).

Dr. JAMES STIRTON communicated a paper on Mosses from West Ross-shire. (*To appear in next issue.*)

Mr. ARTHUR BENNETT forwarded a note dealing with a hybrid *Potamogeton* new to the British Isles (see p. 105).

Mr. GEORGE FORREST and Mr. W. W. SMITH gave an account of certain species of *Dracocephalum* lately obtained in S.W. China (see p. 89).

Mr. CHARLES NICHOLSON exhibited a series of Narcissus Flies belonging to the genera *Merodon* and *Eumerus*.

Dr. A. W. BORTHWICK showed some abnormal Larch cones, the abnormality being due to a check in development.

Dr. A. W. BORTHWICK showed also a shoot of Scots Pine with injury due to some unknown cause, but probably insect attack

Mr. J. LYFORD PIKE forwarded an exhibit of *Ernobius mollis*, Linn., on Douglas Fir.

A restricted session of four meetings only was held during 1915–1916.

PROCEEDINGS

OF THE

BOTANICAL SOCIETY OF EDINBURGH.

SESSION LXXXI

OCTOBER 12, 1916.

SYMINGTON GRIEVE, Esq., Vice-President, in the Chair.

The Office-Bearers of the preceding year were re-elected for the Session.

Sir ARCHIBALD BUCHAN-HEPBURN proposed a motion that the list of members of the Society be printed, and that all names of alien enemies be expunged from the list. Mr. BENNET CLARK seconded the motion. There was no counter-proposal, and the motion was declared carried.

Mr. H. F. TAGG communicated a paper on the Occurrence of Resin Ducts in the Medullary Rays of the Wood of certain Species of *Burseraceae*.

Mr. W. W. SMITH gave an account of the Royal Botanic Garden, Calcutta, with lantern illustrations.

Mr. JAMES SMALL and Mr. W. W. SMITH exhibited a specimen of *Cavea*, a new genus of the *Compositae*, from the Tibetan border (see p. 119).

Mr. GEORGE FORREST and Mr. W. W. SMITH showed specimens of *Trailliaedoxa*, a new genus of the *Rubiaceae*, from S.W. China.

DECEMBER 14, 1916.

SYMINGTON GRIEVE, Esq., Vice-President, in the Chair.

The TREASURER, Mr. RICHARD BROWN, C.A., submitted the following Statement of Accounts for the Session 1915–1916:—

INCOME.

	£	s.	d.
Annual Subscriptions for 1915–1916	£36	15	0
Do. Arrears	3	5	0
Transfer from Life Members' Fund . . .	8	10	1
Transactions sold	3	7	6
Subscriptions to Illustration Fund	1	5	0
Interest on Deposits in Bank	4	7	8
	£57	10	3

EXPENDITURE.

	£	s.	d.
Printing *Transactions* for 1915–1916; *less* Subscriptions received from Authors, £26, 14s. . . .	£11	15	6
Printing Notices for Meetings, etc. . .	8	12	0
Rooms for Meetings and Tea . . .	4	11	4
Stationery, Postages, Carriages, etc. . .	2	12	6
Fire Insurance on Books, etc. . .	0	5	0
Excess of Income over Expenditure . .	29	13	11
	£57	10	3

STATE OF FUNDS.

Life Members' Fund.

	£	s.	d.
Balance of Fund at close of Session 1914–1915 . .	£106	14	0
Add—Life compositions received	11	11	0
	£118	5	0
Deduct—Transferred to Income	8	10	1
Balance as at close of Session . .	£109	14	11

Ordinary Fund.

Balance of Fund at close of Session 1914–1915	£15	5	9			
Add—Increase during Session 1915–1916	29	13	11			
Balance as at close of Session . .				44	19	8
Total Funds . .				£154	14	7

Being:—Sum in Current Account with Union Bank of Scotland Ltd. .	£19	2	0			
Sum in Deposit Receipt with do.	150	0	0			
Due by Treasurer . . .	6	0	1			
	£175	2	1			
Less Printing Accounts outstanding .	20	7	6			
As above . .				£154	14	7

Note.—Subscriptions in arrear, considered recoverable 1914–15, £2, 5s., 1915-16, £3.

EDINBURGH, 20*th November* 1916.—I hereby certify that I have audited the Accounts of the Treasurer of the Botanical Society of Edinburgh for Session 1915–1916, and have found them correct. I have also checked the foregoing Abstract, and find it correct.

ROBT. C. MILLAR, C.A., *Auditor.*

Sir JOHN STIRLING-MAXWELL, Bart., was elected a non-Resident Fellow.

Mr. GEORGE FORREST gave an address on the Flora of Yunnan, with lantern illustrations. The lecturer dealt with the physical features of the country, with its varied and extensive flora, and with the types of hillmen who inhabit the Alpine areas of the province. Many fine examples of *Primula* and *Rhododendron* were shown in their native habitats.

FEBRUARY 8, 1917.

SYMINGTON GRIEVE, Esq., Vice-President, in the Chair.

Mr. CHARLES ELEY was elected a non-Resident Fellow.

The death of Mr. DANIEL OLIVER, an Honorary British Fellow, was intimated; also the death of Dr. JAMES STIRTON, a Fellow of the Society.

Professor BAYLEY BALFOUR communicated a paper on Rhododendrons of the Irroratum Section (see p. 157).

A paper was communicated on behalf of Mr. R. LLOYD PRAEGER, on *Sedum Praegerianum*, W. W. Sm., with a tentative classification of the section Rhodiola (see p. 107).

Mr. ARTHUR BENNETT recorded the occurrence of *Ceratophyllum demersum*, Linn., in the Orkney Isles (see p. 134), and *Ulex nanus*, Forst., in Caithness (see p. 135).

Mr. WILLIAM EVANS communicated a paper giving some Moss Records for Selkirk, Peebles, and the Lothians (see p. 138).

Mr. WILLIAM EVANS submitted, on behalf of Mr. J. C. ADAM, a list of the Mosses of West Lothian (see p. 123).

Mr. CHARLES NICHOLSON sent for exhibition a Longicorn Beetle, *Callidium violaceum*.

Mr. SYMINGTON GRIEVE exhibited a curious miniature Chinese coffin used by the Buddhists for the burial of small mammals and birds.

Mr. KENNETH HAMILTON sent for exhibition a specimen of a new orchid, *Bulbophyllum Imogeniae*, from Nigeria (see p. 228).

APRIL 12, 1917.

SYMINGTON GRIEVE, Esq., Vice-President, in the Chair.

Professor BAYLEY BALFOUR communicated a paper on the Statistics of the Chinese Rhododendron Flora. (To be published in a future issue.)

Professor BAYLEY BALFOUR also communicated a paper on the Development of Rhododendron Seedlings (see p. 221).

Two other papers by Professor BAYLEY BALFOUR were before the meeting, one on *Rhododendron japonicum*, and one giving diagnosis of new species of Rhododendron, chiefly Western Chinese. (To be published in a future issue.)

Mr. WILLIAM EVANS forwarded a paper on Insect Visitors to *Corallorhiza innata*, Br., and some other Orchids in the Forth District (see p. 136).

A restricted session of four meetings only was held during 1915–1916.

PROCEEDINGS

OF THE

BOTANICAL SOCIETY OF EDINBURGH.

SESSION LXXXII

OCTOBER 11, 1917.

R. A. ROBERTSON, Esq., M.A., B.Sc., President, in the Chair.

The following gentlemen were elected Office-Bearers for the Session :—

PRESIDENT.

JAMES WHYTOCK, Esq.

VICE-PRESIDENTS.

ALEXANDER COWAN, Esq.
JAMES FRASER, Esq.
SYMINGTON GRIEVE, Esq.
Dr. A. W. BORTHWICK, D.Sc.

COUNCILLORS.

Sir ARCHIBALD BUCHAN-HEPBURN, Bart.
T. BENNET CLARK, C.A.
R. C. DAVIE, M.A., D.Sc.
JAMES GRIEVE, Esq.
J. RUTHERFORD HILL, Esq.
R. STEWART MACDOUGALL, M.A., D.Sc.
R. A. ROBERTSON, M.A., B.Sc.
W. G. SMITH, Ph.D.
MALCOLM WILSON, D.Sc., F.L.S.

Honorary Secretary—W. W. SMITH, M.A.
Curator of Herbarium—W. CALDWELL CRAWFORD, M.A., F.R.S.E.
Foreign Secretary—The Very Rev. Dr. D. PAUL, M.A., LL.D.
Treasurer—RICHARD BROWN, C.A., 23 St Andrew Square.
Assistant-Secretary—J. T. JOHNSTONE, M.A., B.Sc.
Artist—Professor FRANCIS M. CAIRD, M.B., C.M., F.R.C.S.E.
Auditor—ROBERT C. MILLAR, C.A.

LOCAL SECRETARIES.

Aberdeen—Professor J. W. H. TRAIL, M A., M.D., F.R.S., F.L.S.
Bathgate—ROBERT KIRK, M.D., F.R.C.S.E.
Berwick-on-Tweed—FRANCIS M. NORMAN, R N.
Birmingham—W. H. WILKINSON, F.L S., F.R M.S., Manor Hill, Sutton Coldfield.
Calcutta—Professor S. C. MAHALANOBIS, B.Sc., F.R.S.E., F.R.M.S , Presidency College.
Cambridge—ARTHUR EVANS, M.A.
Croydon—A. BENNETT, A.L.S.
Dundee—Professor P. GEDDES, F.R.S E.
East Liss, Hants—JAMES SYKES GAMBLE, M.A., C.I.E , F.R S
Glasgow—Professor F. O. BOWER, Sc.D., F.R S , F.L.S.
London—WILLIAM CARRUTHERS, F R.S., F.L.S
„ J. F DUTHIE, B.A , F.L.S.
„ E. M. HOLMES, F L S., F.R.H.S.
„ Lieut Col. Sir DAVID PRAIN, M.D., C I E , F R.S., F.L.S., Royal Botanic Gardens, Kew.
Melrose—W. B. BOYD, Faldonside.
Philadelphia, U.S.A.—Professor J. M MACFARLANE, D Sc., F.R.S E.
St Andrews—Professor M'INTOSH, M.D., LL D , F.R S.E.
„ ROBERT A. ROBERTSON, M.A , B.Sc.
„ J. H. WILSON, D.Sc , F.R.S.E.
Toronto, Ontario—The Hon. W. R RIDDELL, B.Sc , B.A.
„ Professor RAMSAY WRIGHT, M.A., B.Sc.

Dr. A. W. BORTHWICK gave an address on Forestry Operations, with lantern illustrations.

DECEMBER 13, 1917.

JAMES WHYTOCK, President, in the Chair.

The TREASURER, Mr. RICHARD BROWN, C.A., submitted the following Statement of Accounts for the Session 1916–1917 :—

INCOME.

Annual Subscriptions for 1916–1917	£31	10	0
Do. Arrears	1	10	0
Transfer from Life Members' Fund	9	0	7
Transactions sold	6	0	0
Subscriptions to Illustration Fund	1	0	0
Interest on Funds Invested and in Bank	5	1	9
	£54	2	4

Expenditure.

Printing *Transactions* for 1916–1917 (estimate), £72 ; *less* Subscriptions received from Authors, £25, 1s. . .	£46 19 0
Printing Notices for Meetings, etc	5 17 0
Rooms for Meetings and Tea . . .	4 18 0
Hire of Lantern . . .	0 12 0
Stationery, Postages, Carriages, etc	3 19 3
Fire Insurance on Books, etc. . . .	0 5 0
Honorarium to Secretary's Assistant . .	2 2 0
	£64 12 3
Excess of Expenditure over Income . . .	£10 9 11

State of Funds.

Life Members' Fund.

Balance of Fund at close of Session 1915-1916 . .	£109 14 11
Add—Life compositions received	10 10 0
	£120 4 11
Deduct—Transferred to Income	9 0 7
Balance as at close of Session	£111 4 4

Ordinary Fund.

Balance of Fund at close of Session 1915-1916	£44 19 8	
Deduct—Decrease during Session 1916-1917	10 9 11	
Balance as at close of Session . .		34 9 9
Total Funds . .		£145 14 1
Being:—£100 5 War Stock, 1929–1947	£95 0 0	
Sum in Current Account with Union Bank of Scotland, Ltd. .	14 10 9	
Sum in Deposit Receipt with do.	80 0 0	
Due by Treasurer .	10 0 4	
	£199 11 1	
Less Accounts unpaid	53 17 0	
As above .		£145 14 1

Note.—Subscriptions in arrear, considered recoverable: 1914–15, £1, 10s.; 1915–16, £2, 5s.; 1916–17, £6.

Edinburgh, 6*th December* 1917.—I hereby certify that I have audited the Accounts of the Treasurer of the Botanical Society of Edinburgh for Session 1916-1917, and have found them correct. I have also checked the foregoing Abstract, and find it correct.

ROBT. C. MILLAR, C.A., *Auditor.*

Mrs. John Law and Mr. J. Lyford-Pike were elected Resident Fellows.

Mr. J. T. Smith was elected a non-Resident Fellow.

Dr. Borthwick gave an account of certain fungi belonging to the genus *Ceratostoma* or *Ceratostomella.*

The Very Rev. Dr. Paul communicated an interesting note on the discovery of *Clathrus cancellatus*, Tournf., in Argyllshire. Dr. Paul also recorded the occurrence in Scotland of *Clavaria aurea* and *C. botrytis* (see p. 301).

Mr. R. A. Robertson delivered his Presidential address, reviewing the task of botanists and scientists at the present time, and emphasised the necessity of an adequate knowledge of chemistry in the solution of biological problems. (To be published in next part.)

FEBRUARY 14, 1918.

James Whytock, Esq., President, in the Chair.

Professor Bayley Balfour communicated a paper on the genus *Nomocharis* (see p. 273).

Professor Bayley Balfour also communicated a paper on new autumn Flowering Gentians from China (see p. 246).

Dr. W. G. Smith and Mr. William Young read a paper on the Flora of Glenshee. A large and beautiful series of dried specimens illustrated the paper.

APRIL 11, 1918.

James Whytock, Esq., President, in the Chair.

Mr. T. Anderson gave a communication on the Principles of Seed-testing.

A paper on the Vegetation of the Ambleside district of Westmoreland was communicated on behalf of Mr. N. M. Johnston.

Mr. W. W. Smith exhibited a new *Rhynchanthus* and a new *Phytolacca* from China (see Notes, R.B.G., Edin., xlix (1918).

PROCEEDINGS

OF THE

BOTANICAL SOCIETY OF EDINBURGH.

SESSION LXXXIII

OCTOBER 10, 1918.

JAMES WHYTOCK, Esq., President, in the Chair.

The Office-Bearers of the preceding year were re-elected for the Session, the office of Treasurer being left vacant.

The PRESIDENT intimated that the following Fellows had died during the past session: Mr. RICHARD BROWN, Treasurer, Mr. W. B. BOYD of Faldonside, Mr. W. C. CRAWFORD, Captain NORMAN, Mr WILKINSON. Mr. J. C. ADAM, a contributor to the Transactions, died on service.

Mr. J. M. MURRAY, Captain WILLIAM STEWART, and Mr. HARRY WATSON were elected non-Resident Fellows.

Professor BAYLEY BALFOUR communicated papers on Rhododendrons of the Triflorum Series, and Critical Points in Description of Species of Rhododendron and Primula, and also Some New or Rare Primulas.

Mr. JAMES FRASER gave an account of a new Grass, *Koeleria advena*, Stapf (see p. 302).

Mr. ARTHUR BENNETT communicated Notes on the Flora of Caithness (see p. 309), and a paper on *Calamagrostis stricta*, Timm, and *C. strigosa*, Wahl. (see p. 305).

Flowers of *Araujia sericifera*, Brot., with moth captured

by its proboscis, were shown from the Royal Botanic Garden.

Mr. SYMINGTON GRIEVE exhibited specimens of Cucumber showing fusion in its fruit; and also abnormal heads of *Plantago lanceolata*, Linn.

Mr. D. M'GLASHAN exhibited specimens of *Melilotus arvensis*, Wallr., 12 feet high.

DECEMBER 12, 1918.

JAMES WHYTOCK, Esq., President, in the Chair.

The following Statement of Accounts for the Session 1917–1918 was submitted:—

INCOME.

Annual Subscriptions for 1917-1918	£27	5	0
Do. Arrears	2	5	0
Transfer from Life Members' Fund .	9	5	10
Transactions sold	10	0	6
Interest on Funds Invested and in Bank	7	9	4
Income Tax repaid	1	19	6
	£58	5	2

EXPENDITURE.

Printing *Transactions* for 1917–1918, £43, 11s. 6d.; *less* Subscriptions from Authors, £36	£7	11	6
Printing Notices for Meetings, etc.	6	16	6
Rooms for Meetings and Tea	4	1	0
Stationery, Postages, Carriages, etc.	2	13	8
Fire Insurance on Books, etc.	0	5	0
Honorarium to Secretary's Assistant	2	2	0
	£23	9	8
Excess of Income over Expenditure	£34	15	6

STATE OF FUNDS.

Life Members' Fund.

Balance of Fund at close of Session 1916–1917 . . .	£111	4	4
Add—Life compositions received	5	5	0
	£116	9	4
Deduct—Transferred to Income	9	5	10
Balance as at close of Session . . .	£107	3	6

Brought forward			£107 3 6
Ordinary Fund.			
Balance of Fund at close of Session 1916–1917		£34 9 9	
Add—Increase during Session 1917–1918		34 15 6	
Balance as at close of Session .			69 5 3
Total Funds . . .			£176 8 9
Being:—£100 5% War Stock, 1929–1947		£95 0 0	
Sum in Current Account with Union Bank of Scotland, Ltd. .		22 9 8	
Sum in Deposit Receipt with do.		80 0 0	
		£197 9 8	
Less—Net Balance on outstanding Accounts .	£15 12 9		
Due to Treasurers	5 8 2		
		21 0 11	
As above			£176 8 9

Note.—Subscriptions in arrear, considered recoverable 1915–16, 15s.; 1916–17, £2, 5s.; 1917–18, £7, 15s.

EDINBURGH, *6th December* 1918.—I hereby certify that I have audited the Accounts of the Treasurers of the Botanical Society of Edinburgh for Session 1917-1918, and have found them correct. I have also checked the foregoing Abstract, and find it correct.

ROBT. C. MILLAR, C.A., *Auditor*

Mr. JAMES WHYTOCK delivered his Presidential Address, giving an interesting retrospect of Sylviculture during the past century, and commenting on the successful introduction of important trees and shrubs during that period.

Mr. ARTHUR BENNETT communicated a paper on *Potamogeton longifolia*, Gay, in England (see p. 312), and also Notes on Dr. Hagström's Critical Researches on Potamogeton (see p. 315).

On behalf of Mr. GEORGE CHESTER, a paper was communicated on Potamogetons in the Canal at Market Harboro', Leicestershire.

Mrs. LAW exhibited an early blossom of *Petasites fragrans*, Presl.

Mr. RUTHERFORD HILL exhibited an example of the Ginger-Beer plant.

FEBRUARY 13, 1919.

JAMES WHYTOCK, Esq., President, in the Chair.

Mr. ANDREW MASON, 23 St. Andrew Square, was elected Treasurer of the Society.

Mr. C. I. BLACKBURNE was elected a non-Resident Fellow, and Mr. N. M. JOHNSON, an Associate Member.

Dr. A. W. BORTHWICK gave a short address on the methods which at present obtain in forest survey. He gave an account of some of the proposals which are at present being put into action with regard to the reafforestation of Scotland. He made the interesting observation that a botanical survey of the areas was found to be one of the most satisfactory foundations for gauging the soil capabilities of the various areas. He further gave an account of the collection of scientific data of growth, etc., in the timber trees of Scotland. On an average it is found that it takes twenty years less to grow sizeable timber in this country than in continental areas. Scotland is found to be superior for timber growing to such an extent that in some cases nearly double the productive capacity is shown.

Mr. H. F. TAGG read a paper on the opening of pine cones, and gave an account of the seed extraction which had been done at the Royal Botanic Garden for the supply of pine seeds to the Board of Agriculture during the war. He gave a most interesting account of the mechanism by which pine seeds are gradually discharged from the cone.

Dr. STEWART MACDOUGALL gave records of the occurrence of ***Myelophilus minor*** in Scotland (see p. 334), and exhibited the work of *Cryptorrhynchus lapathi* (Linn.) on Willow.

Sir DYCE DUCKWORTH sent for exhibition a portion of the famous Dragon Tree at Oratava, Teneriffe, which he had gathered in 1873, and a Stethoscope made in 1872 of wood of one of the largest trees in the Yosemite Valley, *Sequoia gigantea*.

Sir DYCE DUCKWORTH also sent for exhibition a cone from the classical pine forest at Ravenna, gathered in 1865. After a lapse of ten years he had extracted and planted some of the seeds, which all germinated and grew well. They were transplanted in different parts of Berks and Surrey. Those planted on chalky soil, however, died, but those planted in sandy soil thrived well. One of the best specimens is growing in the garden of the Duke of Newcastle at Ascot, and is 18–20 feet high and in fine condition. A cone from it was also shown.

The HONORARY SECRETARY exhibited *Whytockia*, a new genus of the *Gesneraceae*, the generic name being chosen in honour of the present President of the Society (see p. 338).

A sample of German war tobacco was exhibited on behalf of Colonel MACDOUGALL. It was mostly composed of beech leaves: it also contained beech buds, beech petioles, beech twigs, and pieces of petioles of a species of *Nicotiana*.

APRIL 10, 1919

JAMES WHYTOCK, Esq., President, in the Chair.

Mr. A. E. MILLS was elected a non-Resident Fellow.

Professor BAYLEY BALFOUR communicated a paper on *Biltia Vaseyi*, Small, as a type of Rhododendron.

Mr. H. F. TAGG read a paper on the preparation of slide cultures of Moulds for class purposes.

Dr. BORTHWICK and Dr. WILSON exhibited specimens of the Common Spruce attacked by a species of *Cucurbitaria*.

Dr. WILSON exhibited the following Alpine Rust Fungi, which he had recently discovered on the Perthshire mountains and which are new records for Britain:—

Puccinia septentrionalis, Juel, the aecidial stage on *Thalictrum alpinum*, Linn., and uredospore and teleutospore stages on *Polygonum viviparum*, Linn.

Puccinia borealis, Juel, the aecidial stage on *Thalictrum alpinum*, Linn. The uredospore and teleutospore stages

of this species probably occur on *Anthoxanthum odoratum*, Linn., but have not been found in Britain.

Melampsora alpina, Juel, the aecidial stage on *Saxifraga oppositifolia*, Linn., and uredospore and teleutospore stages on *Salix herbacea*, Linn.

He also exhibited Beads from Greece made from wild oranges.

Mr. H. F Tagg showed a collection of photographs illustrating the opening of Pine Cones and the Extraction of Seed from them; he also exhibited some museum preparations of Common Moulds, and communicated details of the methods of preservation adopted (see p. 335).

TRANSACTIONS

OF THE

BOTANICAL SOCIETY OF EDINBURGH.

SESSION LXXX.

Some Plant Associations of N.W. Yunnan.

By F. Kingdon Ward, B.A., F.R.G.S.

(Read 10th February 1916.)

Examination of the flora of any region shows that the plant formations fall naturally into two main groups: the first dependent on the general climate of the region as determined by its latitude and surrounding physiographical features, the climate being described as arctic, continental, temperate, maritime, monsoon, equatorial, desert, and so on; the second determined by local and varying conditions, such as shelter, altitude, rate of change of temperature, or water—factors which modify and in extreme cases mask the regional climate and its effects, while differences of soil introduce a selective element, altering, with the aid of mechanical causes, the plant associations. To the former may be given the name of *dominant formations,* while the latter, which are in the nature of the case numerous in any given region, may be distinguished as *incidental formations,* or *associations.* It will, however, be readily recognised, if this distinction is made, that the terms are relative. A formation such as forest may be dominant in one region—for instance, round the equatorial belt and over a large part of the monsoon area—and incidental in another, as where it fringes a watercourse in arid country; and in Europe the original dominant formations, if temperate—as opposed to coniferous—forest, or grassland (meadow), have often been so much interfered with by man as to be obscured.

In highly mountainous regions it is often very difficult to decide what is the dominant formation, or, more accurately, to what single climatic formation the bewildering series of small plant associations may be assigned. It is only in the foot-hills that a mountain flora betrays not its origin, which may be and generally is another matter, but the dominant climatic formation in the midst of which it is, as it were, a vast incident, or accident On the other hand, when we come to consider a mountainous country the size of Tibet, we are no longer justified in speaking of an incidental formation in the midst of a dominant—the incidental has become the dominant. Here physiographical conditions, altitude and the trend of the mountains themselves, prevail, isolating a specialised climatic area which bears no resemblance to surrounding climates; and here we find a new dominant formation with its own series of incidental formations and plant associations. When, however, we are dealing, not with a great elevated plateau like Tibet, but with a high mountain range or series of ranges traversing two or more climatic zones, the question is more difficult, owing to the dovetailing of one flora into another, with perhaps the introduction of a third flora which has found its way along the range in some former period. In the circumstances it is best to consider the flora of the mountain range by itself, apart from the region in which it is situated; decide which is the dominant formation by reference to the climate; and resolve the incidental formations from it.

The state of affairs alluded to is well illustrated on the Yunnan-Tibet frontier, to a consideration of which this paper is specially devoted, and I shall confine my remarks chiefly to the flora of the Mekong-Salween and Mekong-Yangtze divides, two great parallel mountain chains separated by the deep and narrow Mekong valley. The interest of this region—apart from the jumble of climates: arid, monsoon, temperate, arctic, which succeed one another rapidly in a vertical direction—lies in the fact that it is the meeting-ground for several streams of vegetation. There is, for instance, the Himalayan flora, which has certainly travelled far eastwards into China and southwards into Burma; the Chinese flora, which has also flowed

southwards into Burma; and the Indo-Malay flora which has travelled northwards into the Burmese hinterland and into China, mingling with the descending stream. Naturally, to distinguish and disentangle these conflicting streams of vegetation over so large and diversified an area where several floral regions (*i.e.* regions characterised by endemic species) meet is a difficult matter, with all the fascination of hunting and tracking. This paper, however, has but an indirect bearing on the larger question of origins. The monsoon climate extends, in modified form, as far east as the Salween valley, beyond which everything—fauna, flora, people—changes. Up to a certain point, however, about latitude 28° N.[1] the Mekong-Salween divide too receives a copious summer rainfall from the west, and is covered with mixed forest and dense undergrowth, including many giant herbs. This may be called temperate or mixed rain forest, and it is the dominant formation along the entire length of the range from latitude 28° southwards.

The Mekong-Salween divide, however, to a great extent masks the Mekong-Yangtze divide, acting as a rain screen, so that the latter range, though only a few miles to the east, receives a reduced rainfall, and the dominant formation is no longer rain forest, but coniferous forest and scrub, chiefly oak.

Above the mixed rain forest of the Mekong-Salween divide come several specialised incidental formations, of which the most important are (*a*) *Abies* forest, chiefly confined to the sheer valley walls, well above the stream, but in places disputing the lower ground with (*b*) bamboo brake. Though disappearing from the valley bottoms sooner than *Salix* or *Betula*—which towards the tree limit are much flattened out and stunted by wind,—this *Abies* grows on the precipices, protected from wind, at yet higher altitudes. Where the valley is broad and flat, its floor is occupied chiefly by (*c*) alpine meadow, a growth of tall herbaceous plants with conspicuous flowers, scattered amongst which are alder and birch trees, or in some places

[1] North of this point coniferous forest with a scanty undergrowth predominates, and the flora of the Mekong-Salween divide resembles that of the Mekong-Yangtze divide both in its nature and actual species.

stunted willows. Similar meadows occur in the Tyrol. This meadow occupies all the more level ground, bamboo brake and *Abies* only coming in where the valley narrows and steepens. The gullies, however, which have shot out steep isosceles-triangle-shaped cones of detritus, the broad fan-like base of big boulders tapering more and more steeply up to an apex of sand and pebbles, are occupied, not by *Abies* (except at the very bottom) nor by bamboo, but by (*d*) a peculiar shrub and small tree association of their own; in some places the boulder-screes are overgrown with a dense tangle of rhododendron scrub, 6 or 8 feet high, to the exclusion of everything else.

The absence of trees save from the very foot of the boulder screes is probably due to mechanical causes, trees being unable to maintain their existence in face of the avalanches, whether of rock or snow, which descend these gullies. The alpine meadow seeks light and air, growing in pure sand spread out by the torrent over broad flats, probably silted-up rock basins carved out by former glaciers, for the previous extension of which, in the valleys alluded to, there is ample evidence; while bamboo brake thrives only in the damper, darker parts of the valley, where little sunlight penetrates, though it is hard put to it by *Abies*, whose fastness is the cliffs and mountain sides, encroaching into the valley, especially where the boulder-screes debouch broadly.

The following plants may be taken as representative of the alpine meadow :—

Meconopsis pseudo-integrifolia, Prain; *Fritillaria Souliei*, Franch.; *F. Delavayi*, Franch.; *Primula pseudo-sikkimensis*, G. Forrest; *P. Franchetii*, Pax (rare); *Trollius pumilus*, Don, var. *yunnanensis*, Franch.; *Adenophora* spp.; *Aconitum* spp. (both yellow and blue); *Codonopsis* spp. (twining and erect); *Salvia* spp. (yellow and blue); *Geranium* spp.; *Pedicularis* spp.; *Senecio* spp.; *Umbelliferae*.

The alpine meadow extends into the Burmese hinterland, where I found a luxurious growth above the 'Nmai valley in latitude 26° 45′ N., and again at a lower altitude in the neighbourhood of Hpimaw, latitude 26° N.:—

Meconopsis sp.; *Primula* sp.; *Primula Beesiana*,

G. Forrest; *P. helodoxa*, Balf. fil.; *Thalictrum* sp.; *Codonopsis* sp.; *Aconitum* sp. (twiner); *Allium* sp.; *Corydalis* sp.; *Polygonum* sp.; *Senecio* sp.; *Rumex* sp. (7 feet high); and several *Umbelliferae* were prominent constituents. Several species were identical with those found on the Mekong-Salween divide, on the other side of the Salween.

A not less characteristic association of the Mekong-Salween divide is the undergrowth of the temperate rain forest, which includes the following:—

Umbelliferae (giant herbs, up to 7 feet high); *Thalictrum Delavayi*, Franch. (also up to 7 feet high), *Arisaema* (3 species); *Aquilegia* sp.; *Ribes* spp.; *Paris* sp.; *Convallaria* sp.; *Oligobotrya* sp.; *Lilium giganteum*, Wall. (plants 6 to 7 feet high with racemes of 8 to 12 flowers); *Boraginaceae*; *Filices* (nearly all *Polypodiaceae*, though in considerable variety).

Liliaceae—including *L. giganteum*, Wall., and other lilies, several fritillarias, etc.—are not less characteristic of the open forests in the Burmese hinterland above 7000 feet; also *Arisaema*, ferns, *Ribes*, and so on. But here many ground orchids and begonias add a more tropical touch, which is enhanced by epiphytic orchids, many climbing plants, and trees with plank-buttress roots. The very large leaves of the *Arisaema* spp. and *Lilium giganteum* are characteristic of these open forests unencumbered with bush undergrowth.

Comparing now the flora of the Mekong-Salween divide with that of the Mekong-Yangtze divide to the east, we find considerable differences. The Mekong valley itself is very arid, and displays a characteristic association of plants comprising compact low thorny shrubs (*Sophora viciifolia*, Hance, is the commonest; also a *Berberis*) and a number of rock plants, of which a hedgehog-like *Selaginella* is the most conspicuous. In some places a fine juniper tree grows on the rocky banks close to the water's edge. Ascending the Mekong-Salween divide, this formation rapidly growing richer (including now a *Cupressus*; *Daphne calcicola*, W. W. Sm.; *Androsace Bulleyana*, G. Forrest; *Amphicome arguta*, Lindl.; *Didissandra lanuginosa*, Clarke; and many more species) presently passes

into pine forest, in which oaks, rhododendrons, and other shrubs appear, and this in turn into the temperate rain forest which fills the valleys.

On the Mekong-Yangtze divide, however, this pine forest is wanting; the xerophilous flora of the valley continues to a higher altitude, and then passes into a belt of scrub oak, or in favourable localities a mixed scrub, after which come thin forests of *Abies*, and finally larch. There is no rain forest, and no dense undergrowth, the formation which corresponds to this being a thin open forest with *Picea*, oaks, birches, poplars, and so on, in which shrubs, such as willows, roses, barberry, honeysuckles, etc., actually predominate; and so open is the formation that the undergrowth consists of a few shade plants only, *Podophyllum Emodi*, Wall.; *Pyrola atropurpurea*, Franch.; *Primula lichiangensis*, G. Forrest; *Cypripedium tibeticum*, King; and *Meconopsis Prattii*, Prain, being typical examples where the formation is best developed. In a very few places, by streams, an open grassland appears to a limited extent. *Primula vittata*, Bur. et Franch.; *Androsace spinulifera*, Knuth; *Cynoglossum amabile*, Stapf et Drumm.; and *Trollius pumilus*, Don, var. *yunnanensis*, Franch. are typical plants here Most of the coniferous trees and a large number of deciduous-leaved trees which are a feature of the Mekong-Salween divide are altogether absent, while, on the other hand, the forest belt is largely made up of a few species: *Picea*, oak, birch, and maple below; *Abies*, juniper, rhododendron, and larch above.

The dominant formation on the Mekong-Yangtze divide then is no longer forest, but shrub (or scrub), which covers the greater part of the range: on the most exposed slopes it is always scrub oak; on more sheltered slopes it is mixed, comprising a number of thorny *Leguminosae* (*Caragana*, etc.), *Berberis*, *Jasminum*, *Rosa*, and others; and in the valleys are willows, *Lonicera*, roses, small trees like *Pyrus* and maple, with scattered meadow plants by the streams, the latter, however, including none of the characteristic plants met with in the alpine meadow of the Mekong-Salween divide. Here trees begin to appear—birch and *Abies*—not, however, forming thick forests. It is evident then that on the Mekong-Yangtze divide forest is

an incidental formation; only in a very few favoured spots does it occur to the exclusion of shrub growth, and then it is usually *Abies*, covering only a small area. The greater part of the divide is covered with shrubs, and a thin belt of trees is found at high altitudes. This great difference is largely due to the difference of rainfall on the two divides, but wind is probably just as important, as the following tables suggest. It should be noted that though the change of climate is sufficient to check tree growth on the Mekong-Yangtze divide, and introduce very considerable differences into the composition of the forest and flora generally, it is not sufficiently great to do away with tree growth altogether. Some of the differences in the composition of the flora too must be ascribed more directly to other causes—for instance, the retreat of the glaciers which has plainly modified the alpine flora, though this is indirectly due to the changed climate, which has caused the retreat. There is, however, good reason to believe, as I hope to show in a future paper, that whatever the differences in the flora of the two mountain chains now, and whatever gulf separates them, they must once have been derived from a common origin.

The following tables were drawn up after taking a series of observations with a small instrument, called an evaporimeter, devised by Sir Francis Darwin. It consists of a small cylindrical copper vessel fitted with a lid, and an elbow-joint carrying a capillary tube gauge of glass, with a scale of millimetres. A small frame, inserted through a slot in the lid, serves to spread a small T-shaped piece of blotting-paper which dips into the water. It was not a very satisfactory instrument. as the evaporating surface was, in humid air, too small to give visible results, while, on the other hand, the capillary tube gauge from which the amount of water evaporated was read off, was apt to get clogged during the fine drizzling rains on the Mekong-Salween divide, and so vitiate the readings. Nevertheless it served to give some indication of the comparative rates of *evaporation* at the selected stations (see tables), though the paucity of records, partly owing to the above-mentioned defects, and partly to causes beyond my control, renders the results only approximate. It must not be forgotten that

I.—*Atuntsu*

Date	Temperatures. Max	Temperatures. Min.	Evaporation.	No of hours	Weather Conditions.	Bar.	Altitude.	Average Rate per Hour.
			mm				feet	mm.
June 6	67	43	10	7·2	Continuous sunshine; light breeze	20·60	11,500	1·38
" 7	62·5	42	5	6	Sky overcast; slight drizzle	21·07	"	0·83
" 8	65·2	38·5	11	5	Continuous sunshine, very light breeze	20·72	"	2·20
" 9	67·9	43·4	10	7	" " light breeze	20·73	"	1·43
" 11	65·5	49	10	8	Intermittent sunshine, fresh breeze	20·67	"	1·25
" 19	67·8	51·5	17	7·5	Continuous sunshine, fresh breeze		"	2·26
" 20	69·5	56	5	2	" " light breeze		"	2·50
" 21	67	48·5	5	4	Intermittent sunshine, fresh breeze		"	1·25
" 22	71	49·5	3·2	3·5	Continuous sunshine, very light breeze		"	0·93
July 8	72	51	3·5	4	" " light breeze		"	1·37
" 10	70	52·5	5·5	3	Intermittent sunshine, fresh breeze		"	1·83
11 days	Av. 69·0	Av. 49·4	Total 85·2	Total 57·2	Average rate per hour 1·5 mm			Average 1·5 pr hr

II.—*Mekong Valley.*

Date	Temperature	Evaporation	No of hours	Weather Conditions	Bar.	Altitude	Average Rate per Hour
June 23	Temp 76	4	2	After sunset (7 p m -9 p m) strong breeze	23·7	7,300	2·0
July 4	80	3	1·5	Sun down (5 30 p m -7 p m); strong breeze		"	2·0
[" 4-5	71[1]	10[1]	10[1]	During night (7 p m -5 30 a m)[1]			1·0[1]]
" 5	Temp 83	3	1·25	Sunshine (1 p m 2 15 p m), very strong wind	24·0	"	2·4
3 days	Av Temp 79·6	Total 10	Total 4·7	Average rate per hour 2·1 mm			Average 2·1 pr hr.

[1] Not included in the average.

III.—*Doker la Camp (Mekong Salween Divide)*

Date	Max	Min	Evaporation	No of hours	Weather Conditions	Bar.	Altitude	Average Rate per Hour
June 30	66·5	42	1	2	Intermittent sunshine, fresh breeze	19·96	12,700	0·5
July 1	63	43	4	10	Cloudy, frequent showers	19·96	"	0·4
" 2	63	43	1	3	Cloudy, drizzling	19·85	"	0·3
					Ka' gui-pu Camp (M.-S. Divide)			
July 19		37	10	10	Continuous sunshine, light breeze	18·7	15,136	1·0
" 20	69	39	4	8	Almost continuous sunshine, no wind		"	0·5
" 22	64	40	Not appreciable	3	Cloudy, no wind		"	0·0
	Av 65·1	Av 40·6	Total 20	Total 36	Average rate per hour 0·5 mm.			Average 0·5 pr.hr

Mekong valley .	Average hourly rate of evaporation = 2·1	Ratio 10 : 7·1 : 2·4
Atuntsu .	" " " 1·5	
Mekong-Salween divide	" " " 0·5	

the instrument gives no indication of the rate of *transpiration* of any plant; it only measures the humidity or dryness of the atmosphere, thus corresponding more to a hygrometer.

On examining the tables it will be seen that wind is of more importance than high temperature or sunshine in accelerating evaporation. For example, in Table I the average rate of evaporation for six days, recorded as "light breeze" is 1·63 mm. per hour, and that for four days recorded as "fresh breeze" is 1·64 mm. per hour, though in the former case sunshine is recorded as "continuous" for all six days; in the latter case it is recorded as "intermittent" on three out of the four days. Similarly the average maximum temperature for the six days was 68·7° F., as against only 67·5° for the four days. Again in Table II, July 4–5, the rate of evaporation during the night is significant, as is the rate on June 23 after sunset.

At Doker-la, on the Mekong-Salween divide, the humidity of the atmosphere, owing to the perpetual drizzle, greatly retarded evaporation. The weak points in the tables are of course the small number of observations recorded, the fewness of the stations (though the main ones are dealt with), and the fact that the evaporimeter was not exposed between the same hours each day, nor for the same number of hours. However, the final figures, 10 : 7·1 : 2·4, probably give a fairly correct idea of the comparative rates of evaporation (and hence condition of the atmosphere) at these three places, from which we may infer that wind and rainfall are the most important factors in determining the dominant formation, soil and situation being auxiliary factors, helping to control the incidental formations and select the flora.

We come now to a detailed consideration of the composition of the various formations and plant associations mentioned, and first let us take the temperate rain forest, the dominant formation of the Mekong-Salween divide.

The conifers are *Cunninghamia* (?), *Taxus*, *Picea*, of great size (one I measured was 19 feet in girth, 5 feet from the ground), *Abies*, *Pinus* (2 species), and one I could not identify.

Amongst the deciduous-leaved trees are species of *Pyrus*,

maple, *Tilia*, oak, alder, holly, birch, walnut, and many climbers such as *Clematis* and honeysuckles, *Akebia*, *Actinidia*, *Aristolochia*, shrubs like *Ribes*, *Rubus*, and rhododendron, etc. The undergrowth of this rain forest has already been mentioned, as also the next formation, alpine meadow. Within the limits of the alpine meadow come numerous smaller plant associations dependent on soil, situation, and physical conditions generally, and above the tree limit we come to alpine turf, with dwarf rhododendron. Lastly comes open scree, where a few plants struggle up almost to the snow-line, gradually growing fewer and ultimately disappearing altogether.

Starting then from the Mekong valley, we have in the valley itself a xerophilous flora, then the forest belt, dominant because it is dependent on the climate of this region, hot, wet summers and cold winters with some rain at all seasons; hence it covers the greater part of the range, being absent only where the general climate is subordinated to local climatic conditions, the result of extremes, *e.g.* in the bottom of the Mekong valley, and above 14,000 or 15,000 feet. After the forest belt comes the meadow, incidental because it occurs only to a limited extent in the valleys, dependent on special local conditions, and within the limits of the forest belt; forest is often mixed up with it, and outstrips it. Lastly comes the alpine belt, including scree associations, turf, dwarf rhododendron, and precipice plants, above the limit of trees. Hereabouts the conditions are more diverse than down below, and near the tree limit the plant associations change more rapidly than elsewhere with any change of conditions.

On the Mekong-Yangtze divide we also find three main belts, but the differences, as already pointed out, are striking. The first and dominant formation is the shrub belt, which is a continuation of the xerophilous flora found in the valley. Secondly comes the narrow forest belt, which corresponds more or less to the meadow belt on the Mekong-Salween divide, being confined chiefly to the valleys and having the shrub belt mixed up with it. Alpine meadow. which is dependent on an almost continuous rainfall throughout the vegetative season, and

does not, like the forest, mind wind, is wanting altogether; and the third belt, that of the alpine associations, is much the same as on the Mekong-Salween divide, though not so rich in genera. The differences recorded are not, of course, entirely due to the smaller rainfall on the Mekong-Yangtze divide, considerable modifications having been introduced by the retreat of the glaciers and elevation of the snow-line, as already pointed out. Again, the Mekong-Salween divide is the extreme eastern boundary of the monsoon region, and its climate approaches that of the Burmese hinterland, which has undoubtedly contributed to its flora, while the Mekong-Yangtze divide is cut off from this source of supply by the whole length of the dry Mekong valley; if the latter range ever supported any monsoon plants, they would probably have disappeared before now. Here, however, I am dealing with the formations and plant associations, not with the flora and its origin, which is another matter. While, however, the climatic differences on the two ranges have differentiated the formations and to a considerable extent the flora, this does not obscure the still more remarkable similarity noted, nor conceal the fact that a common origin alone will explain this.[1]

The following lists, of course far from complete, contain the names of certain characteristic plants of each association in the alpine region. Those marked with an asterisk are common to both divides (though it cannot be said for certain that others too are not common), and it is worth noting that the alpine flora of the two divides has a much larger proportion of species in common than the forest or meadow belt, very few species of the latter association being found on the Mekong-Yangtze divide, though many species of both the alpine and meadow belts, of the Mekong-Salween divide, extend southwards and westwards into the Burmese hinterland.

Alpine Turf

**Primula bella*, Franch.
**Primula brevifolia*, G. Forrest.

[1] North of latitude 28° 30′ the formations and flora on the two divides are identical.

Meconopsis rudis, Prain (Mekong-Yangtze).
Meconopsis Delavayi, Franch. (Mekong-Salween).
Primula albiflos, Ward (Mekong-Salween).
**Primula pulchella*, Franch.
**Phlomis rotata*, Benth.
Lilium lophophorum, Franch. (Mekong-Yangtze).
Saxifraga nigroglandulosa, Engl. et Irmscher. (Mekong-Yangtze).
Primula vernicosa, Ward (Mekong-Salween).

Precipices and Rocks.

**Isopyrum grandiflorum*, Fisch.
**Potentilla peduncularis*, D. Don.
**Diapensia himalaica*, Hook. f. et Thoms.
**Androsace Chamaejasme*, Host.
Gentiana sino-ornata, Balf. f. (Mekong-Yangtze).
Primula dryadifolia, Franch. (Mekong-Yangtze).
Cassiope palpebrata, W. W. Sm. (Mekong-Salween).
Rhododendron, scarlet species (Mekong-Salween).
Meconopsis integrifolia, Franch. (Mekong-Yangtze).

Heath.

Rhododendron sp., "black" (Mekong-Salween). [*Rhododendron campylogynum*, Franch. ?]
**Rhododendron* sp.
**Cassiope fastigiata*, D. Don.
**Pinguicula alpina*, Linn.
**Lloydia tibetica*, Franch., var. *purpurascens*, Franch.
Potentilla fruticosa, Linn. (Mekong-Yangtze).
Juniperus sp. (Mekong-Yangtze).
Rubus sp. (Mekong-Salween).
Primula nivalis, Pallas (Mekong-Yangtze).
**Gentiana*, sp.

Screes and Boulders.

**Meconopsis speciosa*, Prain.
**Saxifraga Delavayi*, Franch.
Saussurea quercifolia, W. W. Sm. (Mekong-Yangtze).
Gentiana Georgii, Diels (Mekong-Yangtze).
**Polygonum Forrestii*, Diels.
**Aconitum Hookeri*, Stapf.

Cremanthodium comptum, W. W. Sm. (Mekong-Yangtze).
Lychnis nigrescens, Edgew. (Mekong-Yangtze).
**Arenaria Delavayi*, Franch.
Cardamine granulifera, Diels (Mekong-Yangtze).
**Gentiana heptaphylla*, Balf. f. et G. Forrest.
Crepis rosularis, Diels (Mekong-Yangtze).
Lactuca Souliei, Franch. (Mekong-Yangtze).

ON THE SINO-HIMALAYAN FLORA. By F. KINGDON WARD, B.A., F.R.G.S.

(Read February 10, 1916.)

This is an attempt to explain in some measure the undoubted and long-recognised relationship existing between the flora—at least the alpine flora—of the Himalayas and that of Western China, a country which is one vast complicated series of mountain ranges, not indeed comparable to the giants of the Himalayas in height, but nevertheless of commanding altitude and even more extensive.

It might be urged that there is nothing remarkable in this similarity of floras, both of them alpine: we would, for example, expect dissimilarity between the alpine floras of the Andes and Ruwenzori, or between those of the New Zealand Alps and Kinabalu, but the Himalayas end, geographically speaking, close to Western China and are doubtless connected more or less closely with the Chinese mountains. But the problem of distribution is not so simple as it appears, and moreover there are other intimately related problems which are scarcely explicable on the assumption that the relationship between the Himalayan and Chinese floras is the natural result of present physiographical conditions. It might be, if these mountain systems were actually in contact to-day; but they are not, as a glance at the map of S.E. Asia will show, being breached along the China-Tibet and China-Burma frontier by a number of parallel ranges cutting right across the main axis of the great Asiatic divide. Even so it is less the interpolation of the mountain ranges than the deep arid valleys between them that prove such a stumbling-

block to the student of distribution, and it is evident that we should not find plants common to the Salween-Irrawaddy, Mekong-Salween, and Mekong-Yangtze divides if the present physical features obtained when the distribution took place. Hence, rather than argue that because the mountain systems are connected (which they are not) therefore the floras are similar, we must recognise that because the floras are related, therefore the mountain systems must once have been in closer connection than they are at present.

So much for the main problem. Once we have unravelled this previous continuity of mountain systems, few direct traces of which are left, we may find other difficulties cleared up also.

A question which many English horticulturists who—thanks largely to the public spirit of Messrs. Veitch of Chelsea, and Bees, Ltd., of Liverpool, and to the French Catholic priests before them—have gained some insight into the almost limitless wealth of flora in Western China, are asking themselves is: Whence comes this unparalleled wealth, which (as the acute Sir Joseph Hooker long ago prophesied it would—a prophecy amply borne out during the last two decades by a dozen collectors) more than rivals that of Sikkim?

A critic of mine in the Gardeners' Chronicle, reviewing a book [1] I wrote, in which attention was drawn to the subject, answered this question apparently to his own satisfaction. I must say I thought the explanation rather lame, and moreover the writer was wrong in his facts But the real inadequacy of it lay in the fact that he altogether ignored the effects of plant migration and mixing, and it is on this fact that I am myself inclined to lay great stress. Briefly, if we can find a satisfactory explanation for the close relationship existing between the Himalayan and Chinese floras, I believe we shall have gone a long way towards explaining the wealth of the Chinese flora, to account for which secondary factors, such as abundant rainfall and richness of soil, are quite insufficient.

Closely connected with the above is the special question, to which I shall revert later, Why does the genus *Primula*

[1] The Land of the Blue Poppy: Travels of a Naturalist in Eastern Tibet, by F. Kingdon Ward, B.A. (Cambridge University Press, 1913).

(and perhaps others, *e.g. Rhododendron*) receive as it were a special impetus in Western China and appear there in its greatest variety, though showing at the same time in many cases a close relationship with the species of the next most prolific area, namely the Himalayas? This is of course a special case of the general problem to which attention is drawn above.

Finally we may ask, How is it that though China has a flora peculiar to itself characterised by a number of endemic species, and India has quite a different flora characterised by other endemic species, the whole mountainous country from the Himalayas to China shows an unmistakable unity in its flora, and a dissimilarity to the floras of the surrounding regions in the midst of which it lies, though, as we have seen, the mountain area is not really continuous so far as the emigration of plants is concerned? It might appear, from a glance at the map, as though the Andes and the Rocky Mountains should show relationship in their floras, and, the reverse being the case, we suspect that the isthmus joining the Northern and Southern Continents was recently under water, a suspicion confirmed by geologists. Similarly while the Rockies support a flora intimately related to that of the Continent, the Andine flora has nothing to do with that of South America, being more closely associated with the New Zealand alpine flora, from which it is inferred that the Andes have been peopled from outside after the distribution of the continental flora, and are therefore a comparatively recent uplift.

The same argument may be applied in the case of the Himalayas and Western China.

Having interested myself in the problems here propounded during several years' travel in Western China, I set to work to gather any facts which seemed to bear on the problems of distribution; and finding that the geographical features of the country can be largely traced to comparatively recent geological changes, and that changes of climate which must have taken place will all afford valuable evidence, I pondered over these matters too. No doubt a complete understanding of all such contributory factors will be necessary for a solution of the problem on which I have embarked; and to obtain the necessary

knowledge a vast amount of exploration, some portion of which I hope may yet fall to my share, is still necessary. Nevertheless, inadequate as are the facts so far collected, and though much revision, addition, and correction will be needed as knowledge increases, it seems to me that some useful purpose may be served by the following attempted explanation.

I will begin with a brief description of the frontier[1] region and the distribution of plants there according to climate.

Geography and Climate.

A glance at the map of Asia will show that in the region of longitude 98°–99° E. and between the 27th and 30th parallels of latitude several big rivers break through from Tibet and flow for some distance due south, parallel to one another and close together, being separated by high, narrow ranges of mountains. Further east, and again in Upper Burma, the trend of the mountains is the same, the peaks growing lower as we go south; however, we need not for the present concern ourselves with these minor ranges, concentrating our attention on the three principal ones: namely, the Irrawaddy-Salween, Mekong-Salween, and Mekong-Yangtze divides, the first-named being the most westerly. Beyond the Salween-Irrawaddy divide come the mountains of the Burmese hinterland, the valleys between which are filled with monsoon jungle, which also clothes the mountains to at least 8000 feet. The monsoon climate in fact, characterised by hot, wet summers and a dry season of greater or less extent (which becomes also a cold season in the north and at high altitudes), extends a little further east, into the Salween valley itself, where in the gullies, even as far north as latitude 28°, I have found a monsoon flora with such plants as *Asplenium Nidus*, Linn., the banana, *Asclepiadaceae*, numerous epiphytic ferns and orchids, climbing Aroids, etc. When we reach the Mekong-Salween divide we find that great range also clothed with luxuriant forests and meadows, the former lacking many of the characteristic arborescent monsoon genera, but neverthe-

[1] The frontier between Tibet and Yunnan in the north, Burma and Yunnan in the south, spoken of throughout this paper as the Burma-Yunnan area.

less deserving to be called temperate rain forest, but beyond this the monsoon does not extend. South of latitude 28° the Mekong valley is very much drier than the (monsoon) Salween, and even in the gullies supports little monsoon vegetation, so that the two, separated by a high but narrow mountain range, are in strong contrast. Still further east therefore the change, even on the mountains, is pronounced, and the Mekong-Yangtze divide, instead of being, like the Mekong-Salween divide, clothed with luxuriant forest, is covered with thorny scrub below, coniferous forest above, in which the larch, absent from the Mekong-Salween divide, is predominant at high altitudes. Beyond this range again, in the Yangtze valley, also arid, the flora is typically Chinese, probably without a single Burmese species.

We have then established these facts, namely, that the monsoon carries as far east as the Salween valley,[1] of which the flora (and it may be remarked the fauna also) is closely related to that of the Burmese hinterland; and secondly, that the Chinese flora is found as far west as the Yangtze valley and Mekong-Yangtze divide, so that the two meet hereabouts, but are sharply divided by the Mekong valley and Mekong-Salween divide.

Now, it being granted that the Himalayan and Chinese floras are closely related, we can only suppose either that they have been or are at present in close touch with one another, or that both are derived from a common source.

Owing to the east-and-west trend of the main Asiatic axes of uplift, it is difficult to imagine any common source of supply which is not at one or other end of the axis, thus causing the flora to flow from east to west or *vice versa*, and pass successively from one region to another. The only alternative is to suppose one of the parallel northern ranges, the flora of which was driven southwards by the advance of the ice, as the common source; in this way only could the Himalayas and Western China have been peopled simultaneously instead of successively from a single source. This theory assumes that the Himalayas, the north-and-south-trending ranges already referred to, and the tangled mountains of Western China must once have had practically the

[1] *I.e.* south of latitude 28°. North of this point local conditions make the valley extremely arid. The transition is abrupt and startling.

same flora, and consequently that any differences between them must have arisen since. The differences, however, are marked and will have to be accounted for somehow, so that we are no nearer a solution of the other problems, and the theory will not account for certain peculiarities in the distribution of the genus *Primula*.

If then we reject the theory of a simultaneous origin for these two floras, we must assume that they have mingled, or successively originated from a common source; and having satisfied ourselves that, under present conditions, the Himalayan and Chinese floras are separated by impassable barriers, viz. the north-and-south-trending ranges with deep arid valleys in between—it being a well-established fact that similarity of flora and fauna indicates not only land connection, but in the case of plants the absence of any great physical barrier such as a desert or high mountain chain—we are justified in assuming the previous existence of a continuous range stretching from the north-west frontier to well within China. This hypothetical range, the real previous existence of which I shall endeavour to prove, will in this paper be referred to as the Sino-Himalayan range, while the flora of the Himalayas and of Western China will be referred to collectively as the Sino-Himalayan flora. It will be necessary to inquire in the first instance how this range came to be so completely severed by the north-and-south-trending ranges already described.

Retreat of the Ice: Climatic Changes.

Leaving out of account the question as to how mountain ranges are formed in the first instance, we shall see presently reason to believe that these north-and-south-trending ranges were thrust up subsequent to the uplift of the Sino-Himalayan range, interrupting its continuity; and an examination of the floras of these parallel ranges will give a clue to their mode of formation as an irruption area severing the direct continuity of the Sino-Himalayan range.

Comparing the floras of the Mekong-Salween and Mekong-Yangtze divides, though separated only by the deep and narrow Mekong valley, we find striking differences, not so much in the floras themselves—though that too, especially

in the forest belt, is very considerable—but in the plant formations, showing clearly enough the effects of climate, especially rainfall. But the Mekong-Salween divide, being on the edge of the monsoon area, its flora might be supposed to have originated in the west, while the flora of the Mekong-Yangtze divide might be supposed to have originated in China, thus accounting for any differences observed. I will only remark here that the most typical plants of the monsoon jungles, west of the 'Nmai-hka (or eastern branch of the Irrawaddy), *e.g.* *Pandanus*, rattans and other palms, tree ferns, many species of *Ficus*, climbing ferns (*Lygodium*), etc., are entirely absent from the Mekong-Salween divide, and will prove in the sequel that this range and the Mekong-Yangtze divide, whatever their differences now, must once have had the same flora; further, that the Mekong-Salween divide has still—but may not long retain—the same flora as the Salween-Irrawaddy divide. The obvious inference is that these three parallel ranges were peopled from a common source, and that a change of climate, amounting to a pushing back or limiting of the south-west monsoon, has been, and probably still is, taking place in this area.

During two seasons spent at Atuntsu I have climbed a good deal on the Mekong-Yangtze divide between latitudes 27° and 30°, crossing the range by six passes in all, and one result has been to establish the fact that the glaciers there have retreated some distance and are still retreating. This is proved by (i) an examination of existing glaciers on the range, now little more than shrivelled ice-caps moulded like myxomycetes to the rocks over which they flow, and thrusting out blunt icy pseudopodia as it were into the valley: their bottle snouts and distant terminal moraines, the material of which is already almost wholly rearranged by flowing water, complete the picture of exhaustion; (ii) an examination of other parts of the range, where the deeply eroded U-shaped main valley into which open numerous hanging valleys, the rock basins, mostly occupied by lakes, but sometimes silted up, *roches moutonnées*, occasional moraines, and peculiar cirques at the valley heads, prove that glaciers were once present. In the absence of two familiar indications of past glacial action, namely, striae and perched or erratic blocks, I pictured as well as I could

the appearance of these valleys under ice, and with the vision fresh in my mind, journeyed across to the Mekong-Salween divide in order to examine more closely the largest of its glaciers (flowing to the Mekong) which are so well seen from the former range. These glaciers, it may be remarked, are extremely difficult of access, as they flow in narrow sheer-sided gorges and over steep beds which at one point are generally precipitous or nearly so, so that the glacier comes staggering down in a tumult of fantastic pillars. This comparison convinced me that the rarity of lateral moraines and absence of perched blocks followed naturally in the case of these short[1] steep glaciers, enclosed in gorges, and that did these glaciers on the Mekong-Salween divide disappear, neither perched blocks nor lateral moraines would be left to prove their previous existence, nor would easily recognisable terminal moraines be met with. One important result, however, for which I was not prepared, was the discovery that these glaciers too have retreated some distance, and are evidently still retreating, and, as this is an important point, it will be as well to go into it in some detail. Examining the foot of the largest glacier—the only part of it accessible to any but a party of expert climbers—I found it to terminate in several tongues, sloping gradually to the stream-bed. Down in the valley below were gravel terraces cut out by the stream, and looking up-stream, the left bank (facing south) was seen to be a line of sheer cliffs which soon reached a height of several hundred feet; hanging valleys opened into the main valley on either side, all the streams from the northern ridge cascading on to the glacier. From a little above the glacier foot, and extending for half a mile beyond it down the valley, was a high and steep bank of earth almost bare of plants for half its height, but covered at the summit with forest: this was in fact a very perfect lateral moraine, in which I found scratched stones. Further, the moraine showed indications of a step structure, suggesting periodic fluctuations in the retreat of the ice. The lowest part was quite bare, then appeared a few small plants struggling to establish themselves, while above the highest step (marked A in the

[1] The longest glacier was not more than five miles in length, probably less.

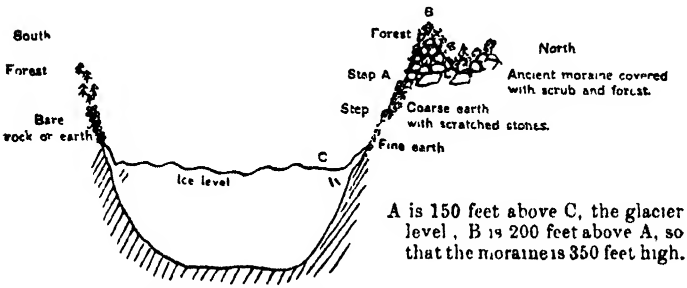
sketch) the moraine was clothed with scrub and forest growing amongst boulders, the material increasing in size from below upwards. Across the valley on the side facing north, the ice lay flat against the sloping valley side a little above the general glacier level, and above that again came a smooth bank of bare rock and gravel, with no plants, evidently left uncovered by the sinking glacier. Fir forests extend right down to the upper limit of this bare bank.

The last half-mile of the glacier surface was fairly smooth and not much crevassed, such crevasses as there were being mostly longitudinal or radial; but looking up the gorge I perceived that the ice stood well away from the cliffs on the north (south-facing) side, so that any material falling from above was, like the streams, instantly engulfed, leaving no trace of a lateral moraine. The Tibetans told me that forty or fifty years ago the ice extended further down the valley, and indeed the boulder-gravel banks and a certain planed appearance of the rocks suggested that it had once nearly reached the Mekong, a distance of little over two miles from the present snout. Finally, at the point where the ice came pouring over the precipice in a fantastic procession of séracs, I found just below the narrow cliff path which winds up the ice of the spur high above the glacier, the well-preserved remains of yet another lateral moraine at least 200 feet above the ice and stranded in a bay of the cliffs.

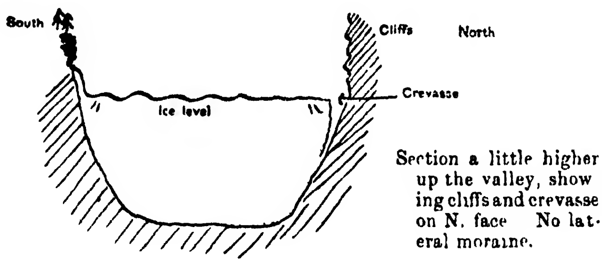
Now is this retreat of the ice apparent or real ?—has the glacier merely carved out this gorge sinking lower and lower, and stranding these moraines as it did so, like certain deceptive "raised" beaches, or has the ice actually decreased in volume owing to diminished snowfall? Bearing in mind that we have established the actual retreat of the ice on the Mekong-Yangtze divide, there is good *a priori* evidence for its retreat in this case also. But we have definite proof of its actual retreat in the extension of a lateral moraine not only for three hundred feet *above* the glacier (see sketch), but also for half a mile *beyond* the present glacier foot. As to how these extraordinary gorges were produced in the first instance, whether eroded by water or ice, is not material, though I confess it is a pretty problem to which I can at present give no answer. The

fact that every valley is broken by a precipice seems to suggest faulting at some period, but there is much in the sculpturing of the region that I do not understand.

I found further evidence of the retreat of the ice on the Mekong-Salween divide. At Doker-la, for example, a pass immediately to the south of the snowy range known as Ka'-gur-pw (an elevated part of the divide), the smoothed U-shaped granite valley is broken near its head by a sheer



Section from N. to S. across the glacier near its snout (diagrammatic).



precipice exactly like that over which the bergs fall in the case just cited, and beyond this is the remnant of a glacier. The shape of the valley, its sheer planed walls on which certain marks like deep grooves are cut, the flat meadows filled with sand (evidently once rock basins), and some enormous boulders which may have been transported, are clear indications of a previous extension of the ice at Doker-la. Again, further north in a smaller glacier valley of Ka'-gur-pw, I found a small lateral moraine tucked away above the ice level, and covered with shrub growth. It is evident that, where the cliffs are not sheer, small lateral moraines can be formed, and one valley head was almost

filled with a terminal moraine, above which fragments of a glacier still lingered.

Having satisfied ourselves that the ice is actually retreating from the Mekong-Yangtze and Mekong-Salween divides, we must ask another question:—Is this due to an actual diminution of the monsoon rainfall, or simply to a local deflection or cutting off of the rain-bearing winds?

Now the direction of the monsoon, blowing alternately from the S.W. in summer and the N.E. in winter, is primarily dependent on the rotation of the earth; and the actual existence of the monsoon, its intensity, and the amount of moisture it carries, on the main distribution of the ocean and continental land masses;[1] and since it is almost certain that no appreciable change has taken place in any of these factors within times so geologically recent as those during which the events we are recording took place—say, within Tertiary times—it follows that any marked decrease in the monsoon rainfall must be ascribed to local causes, namely, a deflection or cutting off of the rain-bearing winds. It might, of course, be objected that the retreat of the ice was due in the first instance to a general rise of temperature over the whole region, and not to diminished precipitation at all. But the fact that the glaciers on the Mekong-Salween divide have been affected considerably less than those on the Mekong-Yangtze divide while those on the Salween-Irrawaddy divide have probably been still less affected—even if they have retreated at all, which may be doubted—points to another cause. If there has been a general rise of temperature, why should it affect the glaciers on one range more than those on another?

The Remnant Flora.

I have said that the retreat of the glaciers is due to a diminution of rainfall, and thereby tacitly assumed that the monsoon, or something very like it, was once felt further east. In that case the Mekong-Yangtze and Mekong-Salween divides must once have had very similar floras, whereas it has been pointed out already that their

[1] The relative distribution of land and sea along the continental shelf has, of course, changed appreciably within Tertiary times, but not their relative proportions, nor their distribution in bulk.

floras are markedly dissimilar, especially in the forest belt, where rainfall counts for more than at higher altitudes. What evidence is there that these floras ever were similar? Overwhelming evidence, in my opinion.

I have hitherto spoken of the Mekong-Salween divide as if it were a single entity as regards its flora; in future it will be necessary to distinguish between the range south of Ka'-gur-pw—the elevated snowy portion referred to above[1]—and that north of it. North of Ka'-gur-pw the appearance and flora of the range are identical with what we are accustomed to on the Mekong-Yangtze divide, proving conclusively the common origin of the two floras. This unexpected but welcome discovery, besides setting at rest any lingering doubts on the latter point, satisfactorily explains another curious fact. We have seen that the principal formation on the Mekong-Salween divide is the temperate rain-forest, which contains some elements at least of the monsoon forests further west, though lacking its most characteristic features, and that this formation is wanting on the Mekong-Yangtze divide, being represented by scrub oak and conifer forest; further that there are on the former range alpine meadows, also represented in the monsoon country to the west, which have no counterpart on the Mekong-Yangtze divide. On exploring the Mekong-Yangtze divide in more detail, however, I came across plants from time to time which seemed to have no business there—plants in specialised situations hidden away in protected gullies, or on an outlier of the divide which captured more than its share of the rainfall. There was, for instance, a plant of *Ribes moupinense*, Franch. I found a single bush of it on a shady mountain slope, outlier of the main divide, and in the same place were several bushes of a species of *Euonymus*, which further research revealed in small numbers in a favoured gulley on the main divide. Both are common in the temperate rain forest on the Mekong-Salween divide. On the outlier above referred to I found *Pinguicula alpina*, Linn., a lucky discovery, though some cliffs on the Mekong-Salween divide were yellow with it;

[1] Ka'-gur-pw is a range of snow peaks, the highest about 19,000 feet, some thirty miles in length from north to south. To the Tibetans this range is sacred.

also a species of *Pyrola*, another lucky find. Less striking examples were *Meconopsis pseudo-integrifolia*, Prain, *Primula pseudo-sikkimensis*, G. Forrest, and one or two others which are found scattered on the Mekong-Yangtze divide in favourable localities, but grow in meadows-full on the Mekong-Salween divide associated with plants such as *Fritillaria Souliei*, Franch., *Aconitum Souliei*, Franch., found nowhere on the Mekong-Yangtze divide. These accidentals, as it were, I have called the remnant flora, as it seems plain they are survivals from a moister climate which have struggled on in a few localities after the bulk of them had perished under new conditions. What these new conditions were I have already indicated—a gradual desiccation owing to the apparent retreat of the monsoon westwards—and both lines of argument (namely, the graduated diminution of precipitation, as indicated by the progressive retreat of the glaciers from the Salween-Irrawaddy to the Mekong-Yangtze divide, and the remnant flora of the last-named divide) point to the same cause. We can only suppose therefore that rain screens have been interposed one after the other between the monsoon in the south-west and the dry regions[1] east of the Mekong-Yangtze divide—in other words, that these parallel north-and-south-trending ranges have been successively pushed up from the west, that the rise of the Mekong-Salween divide curtailed the rainfall, and hence impoverished the flora of the Mekong-Yangtze divide, just as the rise of the Salween-Irrawaddy divide is gradually cutting off the rainfall of the Mekong-Salween divide. Each range acts as a rain screen to the next range east of it. Also it is evident that north of Ka'-gur-pw the Mekong-Salween divide has suffered from lack of rain for exactly the same reason as has the Mekong-Yangtze divide further south, namely, the continued interpolation and elevation of rain screens to the west. It is much less difficult to establish the fact of identity between the floras of the Mekong-Salween and Salween-Irrawaddy divides than between the Mekong-Salween and Mekong-Yangtze divides. As already pointed out, desiccation has not proceeded so far in the former case—the Mekong-

[1] Baber, Johnstone, Wilson, and others have drawn attention to the previous extension of the Szechwan glaciers.

Salween glaciers have not retreated far, and the floras are practically the same to this day. At Hpimaw on the Salween-Irrawaddy divide (latitute 26°) not only was the general facies of the alpine flora the same as that met with at Doker-la (Mekong-Salween divide, latitude 28°), but many of the species were identical: *e.g. Polygonum kermesinum*, Ward mss., *Rhododendron* sp. with "black" (port-wine) flowers: *Orchis Chusua*, Don, var.; *Androsace geraniifolia*, Watt, besides species of *Primula* (§ *Omphalogramma*, § *Bella*), *Thalictrum*, *Cremanthodium*, *Meconopsis*, *Saxifraga*. Thus it would seem certain (i) that these three parallel ranges once had the same flora which, derived from a single source, travelled down the ranges from the north and west (whither all three ranges turn later) and became differentiated at a later date owing partly to (ii) the westward retreat of the monsoon which was cut off from the east by the gradual elevation of the western ranges, and interpolation of more and more mountains, (iii) that in this way two climates, a monsoon climate west of the Salween and a warm temperate climate east of the Yangtze, became sharply defined and separated from each other.

Dispersal of Seeds.

Except under accidental circumstances, the several valleys separating the parallel ranges constitute physical barriers to the spread of plants east or west from one range to another, for the Salween valley north of the Ka'-gur-pw uplift and the Mekong valley throughout its length are extremely arid, and the further one traces them towards their respective sources the more arid do they become However, we have just seen that beyond Ka'-gur-pw the flora on the Mekong-Salween and Mekong-Yangtze divides is identical, both in the forest and alpine belts, so that we cannot doubt the common source to which both ultimately had access. The only means by which seeds could be transferred directly from one range to another would be (i) wind, and (ii) birds. As regards wind, seeds capable of being carried long distances by wind, *e.g.* those of *Compositae*, *Clematis*, etc might be so transferred from range to range, and there are species of *Clematis* (*e.g. C. montana*, Ham.) and

of *Saussurea* (*e.g. S. obvallata*, Wall.) common to both divides. But seeds only indirectly dispersed by wind (whether they are small and light, like those of most Saxifrages and Gentians, or heavier but shaken out of their capsules by gusts of wind, like those of Meconopsis and Lloydia) could not perform the journey from range to range without first establishing themselves in the valley; and, apart from the question of maintaining their vitality under these conditions, once in the valley they would be beyond control of the dominant wind capable of carrying them right across this area, and under the influence of the strong desiccating up-valley wind. Seeds which are normally dispersed by birds are less common, and in this particular case, it must, I think, be an occurrence so rare as hardly to merit attention. It is true that *Podophyllum Emodi*, Wall., occurs both in the Himalayas and on the Mekong-Yangtze divide, and it may have been transported thither by birds. But the case seems exceptional, for most of the plants with edible fruits in the temperate rain forests of the Mekong-Salween divide, which might be distributed by birds, *e.g.* species of *Pyrus*, *Aristolochia*, *Akebia*, etc., are wanting on the Mekong-Yangtze divide.[1] However, the seeds of the majority of the plants common to two or more of the divides are neither such as are transported by birds, nor such as are directly transported by wind, but only shaken out of their capsules by gusts of wind and spread over a limited area in the immediate vicinity: for example, *Primula bella*, Franch., and *Androsace geraniifolia*, Watt, common to all three divides, *Polygonum kermesinum*, Ward mss., *Rhododendron* sp. aff. *Forrestii*, Balf. f., *Lilium giganteum*, Wall., and others, common to the Mekong-Salween and Salween-Irrawaddy divides; *Meconopsis pseudo-integrifolia*, Prain, *M. speciosa*, Prain, *Primula lichiangensis*, G. Forrest, etc., common to the Mekong-Salween and Mekong-Yangtze divides. Conversely, many plants with seeds whirled freely into the air by wind (*e.g.* many Conifers, species of *Cremanthodium*, *Rhododendron*, etc.) are peculiar to one or other divide. Thus the

[1] It is safe to assert that a plant is common to both divides if one has found it on both. To assert, however, that a plant is confined to one divide is obviously unsafe until one has explored every inch of the others. Such statements must therefore be regarded for the present as only comparatively true.

regular transference of seeds direct from range to range is not in accordance with the main facts of distribution on the ranges; still less will it account for any peculiarities in that distribution—for instance, the remnant flora, the greater specific variety on the Mekong-Yangtze divide, and the occurrence of species peculiar to one range (*e.g. Primula Franchetii*, Pax., *Fritillaria Souliei*, Franch., *Cassiope palpebrata*, W. W. Sm., on the Mekong-Salween divide; *Gentiana sino-ornata*, Balf. f., *Saxifraga nigroglandulosa*, Engl. et Irmscher, *Meconopsis integrifolia*, Franch., on the Mekong-Yangtze divide; see footnote, p. 27). Moreover, if wind and birds could be relied on to transport seeds from range to range with some degree of regularity, the floras should be more similar than they actually are, especially in the alpine region, where, as we have seen, the actual climates are not very different. The floras would be adjusted to the circumstances of distribution much more rapidly than either could change owing to changes of climate. But the fact is, even if we assume that a similar flora once clothed all the divides owing to the dispersal of seeds across them, we are still unable to dispense with the theory of successive uplift and formation of rain screens, as this alone would account for the retreat of the ice and the remnant flora. From this we are justified in concluding that the flora has *not* travelled across from range to range, and therefore that it has travelled either down or up the ranges (or both), and hence has been derived from a common source. As it stands, the theory is sufficient to account for all the facts of distribution so far as I know, without dragging in the highly improbable idea that the Mekong valley is not a physical barrier to plant migration. The gradual desiccation of the Mekong-Yangtze divide would bring about changes in the flora, particularly in the forest belt, rain being, as already pointed out, a greater controlling factor in the case of forest than it is with a herbaceous flora, and it accounts readily enough for the remnant flora. It also accounts for a peculiarity alluded to above, namely, the greater specific variety met with amongst many alpine genera on the Mekong-Yangtze divide, *e.g. Meconopsis*, *Gentiana*, *Saxifraga Rhododendron*, *Pedicularis*, etc., a variety greater than anything met with on the Mekong-Salween divide; for as

the glaciers of the former divide retreated, the flora was able to occupy new territory, and, in the inevitable struggle and changed conditions, readapt itself, with the result that new varieties have arisen. But if continuous and free interchange of seeds from range to range took place—and it may be doubted if, under the most favourable conditions, direct communication could be established for wind-borne seeds *except* in the alpine region—there is no reason why these alpines should not now be found on both or all three divides. There is one more significant argument—the alpine and sub-alpine floras of the Mekong-Salween and Salween-Irrawaddy divides are more alike than are the same belts on the Mekong-Salween and Mekong-Yangtze divides, and the same is, I think, true in an even greater degree in the case of the respective forest belts. This follows naturally from the fact that the ice has retreated furthest on the Mekong-Yangtze divide, little or not at all on the Salween-Irrawaddy divide. Such differences as exist between the floras of the Mekong-Salween and Salween-Irrawaddy divides, in the sub-alpine and forest belts, arise from the greater proportion of monsoon species met with on the latter, a subject which will be referred to again. The Mekong valley is as impassable a barrier south of Ka'-gur-pw as it is to the north, but not so the Salween valley which, as already stated, has a more or less monsoon climate south of latitude 28°, so that direct communication between the Salween-Irrawaddy and Salween-Mekong divides is here not improbable. Some of the plants common to the latter divide and to the Burmese hinterland may have crossed directly from one divide to the other; but as it is almost certain that the *alpine* flora common to both divides has travelled down them from the north-west, so is it likely that the southern or monsoon flora, confined chiefly to the forest belt, has travelled up both divides from a common source, and not straight across from the west. The geological history of the western country gives us good grounds for believing *all* the flora common to the Himalayas, the parallel divides, and the monsoon country to have travelled round the perimeter of a circle, and never across it—a matter which will be referred to presently.

Let us now briefly consider the geology of the country,

in order to see if that will furnish a clue as to the building of the parallel divides, and the original connection between the Himalayas and the backbone of China, by which means the similarity in flora must have been brought about. Geology is a subject which permits free speculation, and if in the following notes I have abused the privilege, it is because I have seen but a fraction of the country, and have not gone deeply into the matter. Nevertheless, though it is useless to attempt a detailed description of the region with the scanty knowledge at my disposal, still there are certain prominent and fundamental facts which will go a long way towards telling us what has happened here.

Evidence of Geology.

As far as I have studied the country from the Mali valley in North-West Burma to the Yangtze valley in Yunnan, the mountains all trend from north to south and are separated by deep valleys, which in the north and east are gorges; in the west erosion has been greater than elsewhere, and the mountains are consequently much dissected but often parallel to themselves. There is plenty of evidence to show that volcanic activity has, in the past, played a part in the moulding of the country, though the present manifestations are such as are associated with waning of volcanic forces. Hot springs are abundant throughout the country, and are to be seen issuing from the base of all the parallel ranges; near Tatsienlu in Western Szechwan is a crater lake, and there is another in Upper Burma, while at Tengyueh in Yunnan there is an extinct volcano of very perfect form, with lava beds still intact; a second extinct volcano, Mount Popa, is found in Upper Burma Earthquake shocks are fairly numerous in Western China, Assam, and Burma, and the whole earthquake area here seems to narrow southwards and eventually to tail off along the volcanic line passing down the Malay Peninsula and through the East Indies. The official annals of Yunnan contain the records of many earthquakes, but the most notable in this region are those of 1850 and 1895 in Western Yunnan, and that of 1897 in Bhotan and Assam.

In the rocks too we find evidence of volcanic activity.

Broadly speaking, this part of Asia is built up chiefly of granite and slate, with some limestone, occasionally crystalline. Slates commonly occur in the river beds, and are generally on edge, but metamorphic rocks are also found at 15,000 or 16,000 feet on some of the divides, and perhaps higher still. Similarly granite is usually found forming the bulk of the ranges (*e.g.* the Salween-Irrawaddy divide, at least in the south, and parts of the Mekong-Salween divide), but it also crops out both in the Yangtze and Mekong valleys. However, the plain of Hkamti in Northern Burma, between the eastern and western branches of the Irrawaddy, and the mountains to the south and west, are composed of sands, gravels, clays, and conglomerates, with leaf beds and shells, near Myitkyina slates and mica-schists appear, the former in the river bed, on edge as usual, the latter with sands and clays, heaved up in north-and-south-trending ridges from 3000 to 5000 feet high. The dip of these rocks is usually south-east, and the schists give evidence of considerable pressure

It is quite evident that the whole of this tract, at least from the Mali-hka westwards to the Assam Hills, was once a big lake—it is too big for an estuary, the area under water being about a hundred and fifty miles long by forty or fifty broad; and we now see how it is that plants have not migrated due east across the Burmese hinterland from the Assam side, but must have travelled to the north-east, and *then* come down the parallel ranges. At this period the continuity of the Himalayas with the China axis was probably complete, and the parallel ranges probably had no existence, or were only just beginning to appear.

One of the most peculiar features of the country is its apparent westward tilt, as though it was on an inclined plane. Thus it is found that while the general level of the Mali valley is less than a thousand feet above sea-level (the plain of Hkamti is about 1200 feet), the 'Nmai flows at a higher level, the Salween higher again, the Mekong about 1500 feet above the Salween, and the Yangtze about 1000 feet above the Mekong: yet the Yangtze is the biggest river of all, and the Salween a good second, so that the difference of level cannot be set down to erosion, the Mali being the smallest as well as the most sluggish of all.

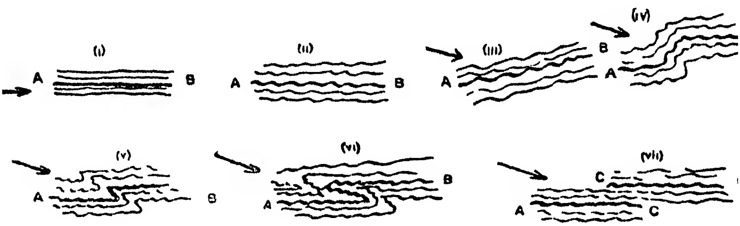
We have already seen good reason to believe that the parallel divides have been gradually pushed up from the west, and if we suppose that the whole area has been bodily pushed up over older rocks, by a movement from the west, we might account for the westward tilt. The highest ranges would thus be found in the east, not only because they would be pushed furthest up the inclined plane, but also because they would have been longest subjected to the pressure. Such a movement might also account for the river gorges, for on cessation of the pressure the weight of the anticlines would tend to drag the mass down the slope again, and the synclines might break. The objection to this is that, if the synclines broke, faulting would almost certainly take place, and probably be conspicuous. I can only say that I have never seen any trace of a fault in any of the river beds, the continuity of the rocks on both sides usually being obvious. On the other hand, some such external force seems to have played a part in the moulding of the country, for the rivers flow quite independently of the strike or dip of the strata, at one point parallel to and a few hundred yards beyond at right angles to the strike, so that apart from such considerations as how much spade-work a river is able to perform under certain conditions, it seems that the valleys have not been simply eroded Taken in connection with the amount of granite we have seen building up some of the ranges, however, there is another possible explanation of this valley formation. When we consider the pushing up of a tremendous range like the Himalayas, it is evident that a great tension must be set up in the adjacent crust, and lines of weakness would be liable to appear at right angles to the axis of the range, running in this case from north to south. Any subsequent pressure acting from one side—say, from the west—would then be apt to make itself felt particularly along these lines of weakness, and in the case of igneous rocks, with the region in a state of greater or less volcanic activity, it would be along such lines that the originally deep-seated granite would be squeezed out. As it burst through and was further ruckled up by the pressure, the natural result would be for it to throw aside the strata, which would thus come to stand vertically, strik-

ing more or less north and south. (The general direction of strike throughout the region is about N.N.E. to S.S.W.)

The curious fact that the tributary streams of the big rivers often flow parallel to the latter for most of their course, before turning abruptly to enter them, thus subdividing the main ridges, and that this tendency is more marked as one goes westwards towards the supposed source of the pressure, seems to me strong evidence in favour of lines of weakness. Thus the parallel ranges come to be more and more closely packed, though reduced in altitude, as one goes westwards: a fact, however, partly to be attributed to increased erosion It is germane to the present discussion to draw atttention to the tremendous lateral extent of the Salween-Irrawaddy divide near the sources of the latter river; and as the Tibetans say it takes seven or eight days to cross from river to river, the range is probably double or treble in this region. Five or six parallel ranges separate the 'Nmai-hka from the Mali, and a still greater number the Mali from the Brahmaputra. It is significant that the great mountain ranges of Central and Eastern Asia trend east and west, and that the rivers which break through this gateway to the south begin by flowing eastwards. This is particularly true of the Tsangpo or Brahmaputra, which for hundreds of miles flows due east, and in a lesser degree of the Yangtze and Salween. The Tsangpo cuts its way right across the main axis of the Himalayas, while the other two swing round through the great gap and flow due south, the Salween maintaining this course alongside the smaller Mekong, while the Yangtze presently resumes its journey eastwards. Before doing so, however, it makes a remarkable loop, not like the usual S-bend, but more like the letter N upside down, thus И. Strangely enough, the same whimsical course is followed by three other rivers in this region: the Yalung, a tributary of the Yangtze further east; the Oui-chu', a tributary of the Salween in Eastern Tibet; and the Ngawchang-hka, a tributary of the 'Nmai-hka in the south.

Now imagine an uplift, simple or of fan structure, its long axis trending more or less east and west, subjected to a gradually increasing pressure from one end, the adjacent country having been, as already pointed out, pulled towards

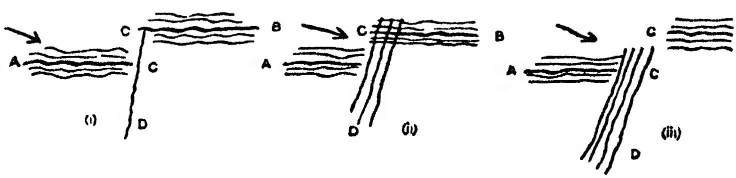
the long axis as the result of uplift, and therefore strained in a direction at right angles to that axis. The uplift might then be to some extent compressed and shortened, and later it might even ruckle slightly; but eventually if the pressure were continued and the mass as a whole did not move, then, unless the direction in which the pressure acted was coincident with the axis of uplift, one of two things must happen: (i) overthrusting of parts of the range, or (ii) bending at right angles to the axis, to be followed by its slewing and eventual shearing. Thus, if the pressure were maintained, we should, in the second case, get structures like the following, as seen in plan, the arrow showing the direction in which the pressure is supposed to act. (AB represents the axis of the original uplift.)



In (vii) shearing has taken place, and the broken ends C C of the axis now overlap. In the last three, the pressure is acting at an angle to the axis.

Imagine these forces (how produced is immaterial, but I have previously suggested a shifting eastwards of the Himalayas to account for the ridging along the border country) at work on a large scale over a wide extent of country, and the pressure to continue after the shearing of the main E.W. uplift (not necessarily a simple syncline) as illustrated. The force is, let it be remembered, acting in a direction more or less at right angles to the lines of weakness already set up by stress in the adjacent crust, owing to that uplift. We should then get, in place of the original lines of weakness, a series of parallel ridges and hollows (anticlines and synclines) running at right angles to the long axis of the original uplift, beginning between their broken ends (C in above diagram), and continuing a longer or shorter distance to north and south, according to circum-

stances. There might at the same time be a slewing round of these secondary ridges while they were being pushed up, or they might from the very first lie rather obliquely to the primary uplift, owing to the pressure acting obliquely as in the diagrams (the Himalayas trend not due east, but about E.S.E.); and they might be pushed up over the broken end of the primary uplift, thus accounting for that apparent westward tilt to which I have drawn attention. Supposing that the irruption area[1] now sagged back, owing to the pressure being released and the dragging weight of the anticlines, the eastern half of the broken uplift might be isolated; while, owing to the oblique direction in which the force is acting (from the W.N.W.), the parallel ridges would lie south rather than north of the gap, and would remain in contact with the western half of the primary



uplift These changes are illustrated in the following series of diagrams, seen in plan.

In (i) we see the effect of continued pressure in the formation of the ridge CD between the broken ends C C of the main uplift AB (see diagram (vi) previously). In (ii) the number of parallel ridges has been increased to three, and they have been pushed up over the broken ends of the eastern half of the original uplift AB. In (iii) the new ridges have sagged back, remaining in contact with the western half of the uplift, and isolating the eastern half.

Now the result illustrated in (iii) seems to me very much the condition of the country under discussion at the present day, the Himalayas being represented by AC, the parallel divides (in the limited sense, that is, the Salween-Irrawaddy, Mekong-Salween, and Mekong-Yangtze divides) by CD, and the backbone of China, the great divide stretching across the country between the Yangtze and Yellow rivers,

[1] By this term I mean the whole country of parallel ridges from the Brahmaputra in the west to beyond the Yangtze in the east.

by CB. There are, of course, hundreds of complicating and modifying factors of which no notice has been taken, and the tangled nature of the mountain ranges with their endless spurs and dividing valleys has been entirely ignored. Nevertheless, I believe that, underlying all the subsidiary details, this fundamental structure can be traced, and that it is readily recognisable on a good physical map of Asia.

Part of the complicated mountain system in Western China is, of course, easily accounted for by erosion; and the more irregular the distribution of rainfall, the more tangled the system. Other irregularities are caused by rivers cutting their way back and capturing other rivers—thus the Yangtze, cutting its way westwards, appears to have captured its present headwaters after the parallel ridges had begun to be thrown up, and the same might be true of the Mekong and Salween cutting their way back to the north. Again, the peculiar courses of the four rivers already referred to may be due to shearing in two directions at right angles, as described above—for it is certain that there have been two sets of uplift acting at right angles to one another, probably alternating. at present it seems that the movement from the west is going on, so that the parallel divides are increasing in altitude as we go westwards, and the ice retreating from those to the east.

In these rather academic speculations on the geological history of the country, I have tried to account for the fact of the retreating monsoon by the theory of rain screens, and for the formation of the rain screens by supposing a pressure acting from the west to have pushed up these parallel divides, thus breaking the continuity of an original Sino-Himalayan range, postulated to account for the common alpine flora from the Himalayas to Western China, and giving us the present configuration of the region; so far as I can see, there is no way of accounting for the Sino-Himalayan flora, except on the supposition of previous continuity.

We now come to the all-important question, How far does the theory account for the actual distribution of plants throughout the region, their mutual relationships, the great wealth of flora along the Burma-Yunnan frontier,

and the directions in which the plant streams have migrated? I must confess that my botanical and geographical knowledge is far from equal to this task; but, as already stated, some advance in knowledge may be made by working with the weapon at my disposal, and I feel sure that botanists who have gone properly into the subject will be able to furnish evidence sufficient either to supplement or to destroy the ideas here put forward.

The Theory Tested.

The best way to set about the task is to ask what might be expected to result, so far as the distribution of plants is concerned, from the above suppositions, namely: (i) a continuous Sino-Himalayan range stretching eastwards into China; (ii) a subsequent breach formed, and a ruckling in the gap such that the broken halves of the original range are completely severed, while the western half remains more or less in communication with the new parallel ranges at right angles; (iii) immense erosion finally separating the parallel ranges from one another, so that the distribution of species on them is discontinuous. At the same time new rivers are formed and old ones rejuvenated, so that, cutting their way back, they are able to capture rivers belonging to the new system of drainage. A mountain range of not too great altitude is an ideal route for the migration of plants, especially above the tree limit. There is, at least in the earlier days of its uplift, nothing to prevent a plant furnished with the most elementary means of seed-dispersal spreading from end to end, as conditions in the alpine belt at least are likely to be very uniform throughout the length of the range. Consequently, there is not much room for variation in the flora on this account. Even though the rainfall may be considerably greater on one range than on the next, and on one part of a range as compared with another part, the atmosphere is often so full of moisture, even when it is not actually raining, that what with the blankets of cloud hanging over the vegetation and the dew deposited owing to radiation from the bare rock, there is little difference in the alpine flora as the snow-line is approached; melting

ice and snow too supply a good deal of the deficit. We are therefore justified in concluding that if the Himalayas reached out into China, we should find a closely related flora occupying its entire length: the differences might be even less conspicuous than those between the N.W Himalayan flora and that of Bhotan to-day, as the continuous uplift of that lofty range has brought about changes which in the early days of uplift would not yet have been effected. There is no reason to suppose that any great fluctuating movement of plants backwards and forwards ever takes place; on the contrary, all the north temperate alpine floras at least seem to have invaded their present homes from certain starting-points and then swept forward the length of the range as though impelled from behind, as indeed they often were by the advancing ice cap during the glacial epoch. Thus it appears that a mountain range is not occupied by plants in any haphazard fashion from the surrounding country, but does actually fulfil its apparent function as a transmitter of plants in one direction.

Now the Himalayas trend about W.N.W. to E.S.E., and it is probable that they received their present flora from the N.W. at the time when the northern flora of Europe was being driven southwards by the ice, for the Himalayan flora is essentially European and Mediterranean, and that owing to the prolongation of the Himalayas eastwards, this flora, once established, would reach China. By the time the vanguard had travelled as far east as it could go, so much time would have elapsed that many changes would have taken place along the length of the range—the disappearance of some species, the domination of others, and so on; in the meantime perhaps uplift has been going on, and the rise of snow-clad portions of the range has cut it up into watertight compartments, so to speak, separated from each other by icy bulkheads between which the floras must henceforth develop independently.

Now suppose the Sino-Himalayan range cut clean across in the manner already described by an uplift at right angles to its axis, as a result of which deep grooves are subsequently trenched between the parallel divides by rivers flowing between. At once the old Sino-Himalayan flora is divided into two camps, an eastern and a western,

between which lies a new line of possible migration southwards. Eventually the new ridges might become severed from *both* ends of the original range: but, to begin with, this is hardly possible, and the irruption area will be in communication with at least one and possibly with both, ends of the broken range. At the present time there seems to be no connection between the irruption area (*i.e.* the Mekong-Yangtze, Mekong-Salween, and Salween-Irrawaddy divides) and the broken ends of the supposed Sino-Himalayan range (represented by the Himalayas in the west and the Sin-ling and Pe-ling ranges between the Yangtze and Yellow rivers in the east); but quite apart from the acceptance or rejection of the Sino-Himalayan range, it is evident that there was once some sort of connection between the Himalayas and at least the westernmost of the parallel divides. Consider the first ridge thrown up at right angles to the axis of the Sino-Himalayan range. it would maintain connection with the western half of the broken range, if formed in the manner I have indicated, and perhaps with the eastern half also. A second ridge thrust up to the west of the first would have a twofold effect. It would, in the first place, be the natural channel of communication between the Himalayas and the south, thus taking the place of the first range which in time would become isolated, being cut off from *both* ends of the broken range, and in the second place it would alter the climate on the latter, and still more the climate further east. Subsequent ridges pushed up in the west would tend to emphasise these functions, so that the most westernly ranges would gradually become the richest in flora, both on account of being in communication with the source of supply (the irruption area not having been yet dissected by rivers) and owing to more favourable climatic conditions. Thus we see that the flora of the Burma-Yunnan frontier (Mekong-Salween and Salween-Irrawaddy divides) would resemble the Himalayan flora more closely than does the North China flora.[1]

[1] By the North China flora I mean that of the eastern half of the old Sino-Himalayan range, the Sin-ling and Pe-ling ranges between the Yangtze and Yellow rivers. The Himalayan flora is that of the western half.

The following consideration will show that the flora of the eastern range will soon lose many of its Himalayan characteristics. The first hint of an irruption area breaking the continuity of the Sino-Himalayan range and trending from north to south would modify the distribution of climate along that range east of the break, especially as regards the monsoon: it might still receive copious rain, but its seasonable distribution would be different, since the new ranges would to a large extent deflect the south-west winds. The result would be a disturbance of the adjustment reached by the eastern flora, with consequent variation and redistribution till a new adjustment was arrived at, and the point to which I would draw particular attention is that, with the irruption area acting as a channel of communication southwards, two *different* floras will eventually travel down it from the severed ends of the Sino-Himalayan range, and, at least in the early stages, before deep dividing grooves have been cut between the dividing ridges come into contact. The result would be, not only a new flora, richer than either of its component streams but a new impetus to variation, partly owing to this mixing of types and partly owing to the greater range of climate encountered during a journey southwards from a continental towards a maritime region—a range still further increased by the retreat of the ice from the easternmost divide, as explained at the beginning of this paper.

Finally, with regard to the parallel ridges themselves, the flora of the most easternly (the Mekong-Yangtze divide[1]) would bear less resemblance to the Himalayan flora than does that of the most westernly (the Salween-Irrawaddy[1] divide), for the reasons stated above; the increased precipitation falling on the western rain screen as a result of the new uplift seems to have given rise to the Irrawaddy, thus draining the lake region and leaving behind the plain of Hkamti.

I have already remarked that the Himalayan flora probably travelled south owing to the fact that the last formed of the parallel ridges was always in more or less

[1] There are numerous north-and-south-trending ranges east of the Yangtze and west of the Irrawaddy, but we are not concerned with these just now.

direct communication with the Himalayas and is probably only separated from it to-day by the Brahmaputra valley. The eastern divides must soon have severed their connection with the western half of the Sino-Himalayan range (though, as we have seen, the floras of the Mekong-Yangtze and Mekong-Salween divides are practically identical in the north) and were probably never in contact with the eastern half; for at their northern extremities all the parallel divides curve round towards the west. Some other cause must therefore be sought to account for the supposed movement of the eastern flora southwards. It seems probable that the real cause in this case was the advance of the ice during the glacial epoch, driving the flora southwards and westwards, by which means not only were the two separated Sino-Himalayan floras brought once more into contact under new conditions, but apparently yet another disturbing element added to further enrich the growing flora of the parallel ridges.

Baber, Johnstone, Wilson, and others have pointed out the widespread glacial phenomena in Western China, and Wilson [1] shows that the Chinese flora, the richest temperate flora in the world, is more closely related to that of the east coast of the United States than to that of the Eurasian Continent. Thus it is evident that in China there has actually been a movement of the flora westwards, and I think it extremely probable that some portion of this extra-continental flora reached the parallel divides, and, mingling with the two halves of the old Sino-Himalayan flora, travelled southwards, giving us the richest alpine and mountain flora within the richest temperate flora in the world, along the Burma-Yunnan frontier. For example, *Juglans* and *Magnolia*, two typical genera of the Eastern United States, are also common on the parallel divides.

Let us now examine a single genus of plants and see how far its distribution is accounted for on our theory —namely, an original Sino-Himalayan range stretching across uninterrupted to China, its continuity subsequently broken by the pushing up of the parallel divides, thus dividing the region into three great plant areas show-

[1] A Naturalist in Western China, by Ernest Wilson (London, Methuen).

ing more or less close relationship: namely, a western, an eastern, and a southern, to be called respectively the Himalayan, the North China, and the Burma-Yunnan floras. For this purpose we will take the genus *Primula*, as, Primula-hunting having become a cult, a very large number of species are known and the genus has been the subject of classical work. It is an Eurasian genus, and only one species in either hemisphere extends south of the Equator. *Primula* is divided into a number of sections based chiefly on similarity of habit and foliage, shape and method of dehiscence of the capsule, type of flower, inflorescence, and so on.

Taking Professor Balfour's classification, and looking at the three plant areas we have mapped out as the result of breaking the Sino-Himalayan range, we ought to find, if the genus *Primula* typically represents the case:—

(i) A Himalayan Primula area with endemic species, (ii) a North China Primula area with endemic species, and (iii) a Burma-Yunnan Primula area richer than either of the others in endemic species, but related to both. Area (i) should differ widely from area (ii)—more so than it differs from (iii), the far ends especially being in contrast while the two ends at the break might not differ so widely; but area (iii) should show obvious connecting links with both (i) and (ii), having derived elements from both, especially in the north, in the region of the break, though there is always the possibility of such links being completely wiped out in such a vortex of change, with two or three different floras crowding through this narrow gap.

Now what do we actually find to be the case?

To begin with, Bhotan and Sikkim together form a very rich Primula area—the richest known till the exploration of Yunnan was begun by the French Catholic priests and carried on so successfully by Forrest; the eastern end of the Himalayas may be regarded as area (i), which, as Sir George Watt points out, grows poorer (in Primulas) towards the north-west, while the types attain their fullest development towards the south-east, that is to say, in area (iii). Area (ii) comprises Eastern Szechwan, and extends northwards into Kansu and eastwards through Shensi, where the Sin-ling range is well defined. Its western

boundary is not very distinct, but may perhaps be found somewhere up in the Koko-Nor district. where the Sin-ling range emerges from the tangle of mountains at the northern edge of the Tibetan plateau. It may be considered as extending to the coast (actually the great plains of the Yellow river and the Yangtze intervene), keeping north of the Yangtze, and though not a rich Primula area its flora is in other respects equal to that of any other region of China. The Burma-Yunnan area comprises for our purpose the three great parallel divides between the Eastern Irrawaddy (or 'Nmai-hka) and the Yangtze; but a good deal of country to the east. including a large part of the provinces of Szechwan and Yunnan, must be included in any comprehensive survey of the region. Though the mountains to the west of the 'Nmai-hka belong to the same great system of parallel divides, they, on the other hand, evidently do not belong to this plant area, as I shall endeavour to show later.

In the following table the Primula sections are arranged according to their distribution amongst the three areas named, omitting those from the Tatsienlu area (Western Szechwan), which, as already pointed out, belongs strictly speaking to, or rather is a direct continuation of, the Burma-Yunnan area. Numbers in brackets refer to the number of species in the section. It is almost superfluous to remark that additions and corrections innumerable, some of which may easily be fatal to these arguments, will probably have been made in the classification before this paper is finished —some of my own Primula finds of 1913–1914 are necessarily excluded; but as far as possible I have followed Professor Balfour's classification. For the Chinese Primulas this was comparatively easy, as I have before me Professor Balfour's paper read before the Primula Conference of 1913. Without the knowledge which it contained, and the inspiration it gave, I take this opportunity of saying my paper would never have been written. But for the Indian Primulas it is less easy, as I am not altogether certain of his classification and may have to some extent confused it with the earlier classification of Sir George Watt, to which I must also acknowledge my indebtedness. However, I have done the best I can to be consistent.

North China.	*Burma-Yunnan.*	*Himalaya.*
Obconico-Listeri (1).	Obconico-Listeri (1).	Obconico-Listeri (1).
...	Cortusoides (2).	...
Mollis (2).	Mollis (1)	Mollis (1).
.	Geranioides (2).	Geranioides (2).
Malvacea (1).	Malvacea (4).	
...	Chartacea (1).	...
...	Davidi (1).	...
...	Sonchifolia (3 ?).	(Allied P. Whitei.)
...	Carolinella (3).	...
Petiolaris (1)	Petiolaris (2).	Petiolaris (13 ?).
. .	Malacoides (2).	...
...	Suffruticosa (9).	Suffruticosa (2).
...	Muscarioides (5).	Muscarioides (1).
Soldanelloides (2).	Soldanelloides (3).	Soldanelloides (5).
..	Dryadifolia (2 ?).	.
Candelabra (1)	Candelabra (9).	Candelabra (3).
..	Amethystina (3)	Amethystina (1).
...	Sphaerocephala (2).	Sphaerocephala (6 ?).
Denticulata (1)	Denticulata (3)	Denticulata (1).
..	Glacialis (3).	.
.	Tongolensis (1).	.
...	Sikkimensis (8)	Sikkimensis (3).
Nivalis (1).	Nivalis (6)	Nivalis (3)
...	Omphalogramma (4).	Omphalogramma (1).
.	Bella (1)	Bella (1).
. .	Minutissima (1)	Minutissima (4).
. .	Yunnanensis (5).	Yunnanensis (4 ?)
Auganthus (1).		
Maximowiczii (2).		
Filchnerae (1).		
Auriculata (4).		. .
Souliei (2).		..
Farinosa (2).		Farinosa (7 ?).
Macrocarpa (1).		...
Sertulum (2).		.
	[Pycnoloba (1 Tatsienlu)]	Verticillata (1).
Totals § 16, sp. 25.	§ 27, sp. 87.	§ 19, sp. 60

A study of the above table brings out the following interesting points. In the first place, the irruption area is by far the richest, both in sectional and specific variety. If we extend the area eastwards to Tatsienlu, where the main ranges still trend north and south parallel to our divides, we must increase the number of species to a hundred; but in order to emphasise the points this table brings out, I have confined the Burma-Yunnan area to the divides already described.

In the second place, the Burma-Yunnan area contains elements from both the other areas, no less than seven

sections being represented in all three areas: it is noteworthy that only *one* section (Malvacea) has representatives in the North China and Burma-Yunnan areas, but not in the Himalayas; and only *one* section (Farinosa) has representatives in the North China and Himalayan areas, missing the Burma-Yunnan area. But the section Farinosa is as much American as Himalayan, and may have reached Asia *via* the Aleutian Islands or by whatever route the American flora travelled west—though I think it more likely that both floras were derived from a common source, and radiated from the far north, than that an actual emigration took place.

Thus we see that seven widely distributed sections have representative species in all three areas, while most of the others which occur in the Himalayas spread south into the Burma-Yunnan area, and are represented there by a larger number of species than in the Himalayas.[1] This is the case with six out of eight sections confined to these two regions, but the increase of species is conspicuous in no less than nine sections, including those with forms in North China as well In two groups confined to the Himalayan and Burma-Yunnan areas (Minutissima and Sphaerocephala) and in one common to all three areas (Soldanelloides) there is a decrease in passing from the Himalayan to the Burma-Yunnan area. Finally, two Himalayan sections (Farinosa and Verticillata) have no representatives in the Burma-Yunnan area. The former is, as already remarked, as much American as Asiatic, and had probably spread over Asia long before the break in the Sino-Himalayan range was formed, there is no *a priori* reason why it should have travelled south with other forms, though it may have done so and since disappeared, or forms of this section may yet come to light in the South. The latter is a N.W. Himalayan type developed in Afghanistan and Abyssinia. These exceptions, if they are exceptions, may all need correction as the exploration of Yunnan and

[1] Sir George Watt, of course, more than hints at the same conclusion when he says: "The forms that spread eastwards from Sikkim to Assam, Burma, and Manipur are seen to belong to an assemblage that attains its greatest development in China, more especially in the mountains of the province of Yunnan" (Observations on Indian Primulas).

the Burma frontier is continued; for while it seems probable that the Himalayas (except perhaps Bhotan) will not yield many new Primulas, there are probably a large number still to be found in the Burma-Yunnan area, the difficulties in the exploration of which can hardly be exaggerated.

The richness of the Burma-Yunnan area is shown as much by the fact that it has nine sections confined to it as by the increase of Himalayan forms there, while the isolation of the North China area is shown by the fact that, in spite of its comparative poverty in Primulas, it also has seven sections confined to it, several of which are unique in the genus. This is an argument in favour of the belief that the North China area has not been recently in communication with the Burma-Yunnan area, or at least not as recently as has the Himalayan area, which it seems possible to me may still be in some sort of communication with it.

A consideration of these facts seems to show then that, so far as the broad distribution of the genus is concerned, they fit in with the theory of a Sino-Himalayan range which has been breached, the eastern end being isolated and the western end remaining more or less in communication with the south, at least till a much later date, *via* a series of curved ranges, wherein, partly owing to its sources of supply and partly owing to physical conditions, changes of climate, soil, and so on, a new and richer Primula area has come into existence, still further augmented by the influx of eastern forms driven backwards and southwards by the ice. Mr. Farrer says that crosses between Primulas occur most frequently, if not exclusively, between extreme species of the same section—in other words, between species of different subsections within the limits of a single section. For example, in the section Candelabra, which forms two colour-groups, we might expect one of the yellow group to cross with one of the purple group, but not a purple with a purple or a yellow with a yellow.

Now at a time when the flora of the earth was more uniform than it is at present—say, in early Tertiary times—the flora of such a continuous range as the Sino-Himalayan would show no very great variation, and Primula itself

might show variation only to the extent of subsectional value, and that only towards the extreme ends of the range. Consequently with the coming of the break, and the subsequent driving in towards the common centre of the eastern and western floras, by the means indicated, these varieties might be brought together at the break, and, travelling southwards in company, give rise to a host of new forms.

It need scarcely be said, however, that if the Sino-Himalayan range theory is to account for the broad distribution of the Primulas in this part of Asia, it must also to a large extent account for (i) any peculiarities of distribution in the genus, both in Asia and elsewhere, since these three areas now constitute the great Primula area of the world, accounting for about 80 per cent. of known Primulas; (ii) for the distribution of other alpines in this region; and (iii) for the distribution of plants in the valleys as well as on the ridges, and for the limits of meeting floras, *e.g.*, the Chinese and monsoon (Indo-Malayan).

To take first the detailed distribution of one or two sections which call for remark. The range of § Candelabra is as follows. Two yellow-flowered species occur in the Himalayas, and the section then expands as usual along the Burma-Yunnan area, where we find three yellow-flowered species (a fourth is known from Tatsienlu) and a new colour group (purple) with five species, the group extends westwards into Burma, where *P. helodoxa*, Balf. f., and *P. Beesiana*, G Forrest, are found, and southwards into Java, where a single yellow-flowered species is found. Now going east across the irruption area we find one purple-flowered species in Eastern Szechwan—but this may belong to the Burma-Yunnan area—and two purple-flowered species from the Far East, one Japanese and one Formosan. Here it appears that the purple-flowered species of the east and the yellow-flowered species of the west have met in the irruption area and travelled south in company, giving a fresh impetus to development in the section.

It may be pointed out here that nearly all the Burmese Primulas known are really Yunnan Primulas. I myself found more than a dozen species on the western slopes

of the Salween divide in 1914, and these include *P. obconica*, Hance, *P. Beesiana*, G. Forrest, *P. helodoxa*, Balf. f., *P. bella*, Franch. (I believe), *P. sonchifolia*, Franch., and perhaps two more of the § Sonchifolia, one of § Omphalogramma, and at least three new species not yet assigned to their proper sections, besides others. Yet I believe very few Primulas (*e.g.*, *P. Listeri*, King) have been found in Western Burma, though the mountains on the Burma-Assam frontier are quite high enough for them; while I venture to prophesy that, high as are the ranges which separate the 'Nmai-hka from the Mali-hka, very few Primulas will be found there when those unknown mountains, so well seen from Laza, come to be explored. For the same reasons, stated below, I believe that few Primulas will be found on the high mountains which, curving round from Assam north-eastwards, form the northern boundary of Burma, as far as the point where the 'Nmai-hka cuts through. West of the 'Nmai-hka the flora is entirely Indo-Malayan and monsoon Screw-pines, rattans and other palms, tree ferns, and a great variety of *Ficus* trees, epiphytic orchids, climbing Aroids, etc., grow there in profusion. Crossing the divide (8000 feet) between the 'Nmai-hka and the Mali-hka in latitude 27°, not only did I see no sign of any Primulas on any of these parallel ranges, but no sign of anything other than endless monsoon-forest; yet many species of Primula grow below 8000 feet, amongst an assemblage of alpines or subalpines, under very similar conditions of climate, in the Hpimaw Hills.

P. Forbesii, Franch., is recorded from the Shan States, Burma, but Professor Balfour remarks that he doubts the identification. There would, however, be nothing remarkable in its appearance on the eastern frontier, as regards distribution; but when Mr. W. G. Craib remarks[1] of *P. obconica*, Hance, recently said to have been found in Upper Burma (probably the same plant that I came across), "This is the first record of its occurrence in India," he must be interpreted as referring to a corner of Further India. For the purposes of distribution, Burma east of the 'Nmai-hka is part of the Yunnan area, while the Assam-Burma frontier is linked up with the Himalayas.

[1] Journ. Roy. Hort. Soc., xxxix (1913), p. 186.

I have already referred to the expansion of the Himalayan Primulas as the Burma-Yunnan area is reached; in no sections is this more prominent than in sections Suffruticosa, Muscarioides, Sikkimensis, and Omphalogramma, none of which have representatives in the North China area; but it is equally conspicuous in the sections Candelabra and Nivalis, each of which has a single representative in North China. The two last named are widely distributed—the Nivalis section is universal through *P. nivalis*, Pallas, itself. however, the first four named seem to have originated in the Himalayas and thriven in the Yunnan area, at least they are found nowhere else. One section, Auriculata, confined to North China so far as the three areas under discussion are concerned, is well represented outside China, and suggests in its distribution that the North China area may have been peopled from North Central Asia as well as from the Himalayas, driven thither southwards by the ice But § Auriculata is nearly related to § Farinosa, a typical American section with representatives also in Japan, so that we have here in these two sections evidence for that westward movement of the flora from America, *via* Japan, already referred to, or possibly Auriculata came from Europe. Anyone who has followed the argument so far will now see why it is that the Himalayan flora is richly represented in Yunnan, but poorly in Western Burma and North China As Sir George Watt remarks, the forms abundant in Sikkim and Bhotan attain their greatest development in Yunnan, but evidently *not* across Assam and Burma from the west, as might seem the most natural route considering the trend of the Himalayas, a prolongation of which in the same direction would cross the richest Primula area in Yunnan. On the contrary, the alpine flora of N.E. Burma which penetrates southwards to within a degree or two of the Tropics has travelled right round in a vast semicircle from the east end of the Himalayas *via* the mountains north of the Irrawaddy sources, and may possibly still be in communication with the supply. I think there can be no doubt on this point from what I have said on the flora of the parallel divides, evidently derived from a common source, and from the fact that near Hpimaw (lat. 26° N.E. frontier), on the

Salween-Irrawaddy divide, as previously stated, I found not only Primulas but Rhododendrons, species of *Polygonum*, *Orchis*, *Thalictrum*, *Androsace*, and other plants, identical with those found at Doker-la on the Mekong-Salween divide, latitude 28°, besides *Meconopsis*, *Saxifraga*, *Pedicularis*, *Cremanthodium*, *Allium*, and other typical genera of plants.

On this view, such Primulas and alpines as have already been found on the Assam-Burma frontier, and such as may yet be found on the mountains of Far Northern Burma—and I think that the Primulas, at least, west of the 'Nmai will not be numerous—are mere outliers, stranded and isolated, having no connection with the source of supply and failing to find their feet under conditions of climate which are not typically alpine, using that term in a restricted sense. In the same way, the comparative poverty of the eastern end of the original Sino-Himalayan range may be ascribed to the fact that, in spite of the two floras which have swept across it, one from the west and one from the east, it is nevertheless a blind alley, isolated from the present main line of migration of the Primulas. Personally I have never seen a finer alpine hunting-ground than the limestone mountains of Kansu and Shensi, on the great backbone of China; unfortunately I climbed there in the depth of winter when everything was under many feet of snow. However, it does not seem to be rich in Primulas, and the flora is more Chinese than Himalayan, and has probably derived much of its flora from America, which is poor in Primulas. The fact that the great plain of Northern Burma must have been a big lake previous to any great ridging of the Burma-Yunnan frontier took place (for the lake bottom itself is now included in the system of parallel ranges), and therefore previous to the breaching of the Sino-Himalayan range, is sufficient proof that there could have been no communication directly across the Burmese hinterland south of the Irrawaddy headwaters.

But if these arguments hold good, and if there is to this day some line of communication between the Himalayas and the westernmost of the parallel divides (*i.e.* the Salween-Irrawaddy divide) which has not been completely severed, as the divides seem to have been from each other, there must be some remnants of this range, which is nothing less

than a remnant of the old Sino-Himalayan range between the Himalayas and Kansu, especially as the Salween flows eastwards to begin with, parallel to the Brahmaputra or Tsangpo. Undoubtedly such a communication range does exist. It has recently been shown that the Brahmaputra cuts across the main axis of the Himalayas, and a tremendous peak in the N.E. corner of Assam has been identified as situated on the axis. This is what I should have expected, and I will go further and say that there exists a great range of mountains to the south of the Salween sources, reaching from near the Brahmaputra (which has cut across it) on the west, to the sources of the Irrawaddy (Taron) on the east, where it joins on to, or rather becomes, the Irrawaddy-Salween divide, and that that range, the real Sino-Himalayan range, the westernmost peak of which is the snowy giant referred to above, is the home of the Primula and the Meconopsis, the link between the Himalayas and Yunnan.

North of this range the Salween sources themselves probably rise in very dry country, but the southern slopes at least of the range will receive a copious rainfall, not inferior to that of the Salween-Irrawaddy divide itself, and should have an ideal climate for the development of a rich alpine flora.

It may be remarked here that the high peak east of the Brahmaputra on the main axis of the Himalayas is well north of the general trend of that range from W.N.W. to E.S.E.: reference to fig. (vii) on p. 34, and to fig. (iii) on p. 35 suggests the reason for this, and is evidence in favour of that theory.

Finally, we have to consider the valley floras, and the meeting of monsoon (Indo-Malayan) and Chinese floras on that vast meeting-ground, as I have attempted to delineate it, the Burma-Yunnan frontier.

I have already mentioned that the Mekong-Salween divide must be considered in two parts, separated by the snow massif of Ka'-gur-pw. North of that uplift the flora of the divide is similar to that of the Mekong-Yangtze divide to the east; south of it, to the flora of the Salween-Irrawaddy divide to the west. The inference, therefore, is that the divide has been peopled partly from the north and partly from the south (*i.e.* the Indo-Malayan region), though

the similarity of the Mekong-Salween and Salween-Irrawaddy floras also extends to the alpine flora, of course derived from the north. In the valleys we find the same thing. As far north as latitude 28°, where these rivers, breaking through from Tibet, flow in narrow arid trenches, cut off from the rain-bearing winds by the western ranges, and still further desiccated by the indraught of hot air rushing through them, we find at least indications of an Indo-Malayan flora which has spread up from the south. In the Salween valley this is obvious enough, as there are palms, giant bamboos, *Asplenium Nidus*, Linn., and other ferns, Aroids, orchids, and other typical Burmese (monsoon) plants; in the case of the narrow Mekong valley, however, it is only in the shaded gullies that these monsoon plants have a chance of establishing themselves, and there we find *Musa*, *Asclepiadaceae*, ferns, *Citrus*, and other Burmese plants. The flora of the Yangtze valley is much more Chinese. Before the parallel divides had reached any great height, or before the Sino-Himalayan range had been breached, when the Burmese hinterland was a big lake, and the monsoon extended eastwards along the southern slope of the Sino-Himalayan range, all this country would be covered with monsoon forest, and what now remains is evidently the remnant after the advance of the Himalayan and Chinese floras consequent on the rise of the mountains and cutting off of the monsoon rainfall.

Summary.

I have shown that the distribution of floras on the Mekong-Yangtze and Mekong-Salween divides is in accordance with the theory that the parallel divides have been pushed up one by one from the west, the first to appear being the easternmost; also that these two divides and the Salween-Irrawaddy divide derived their floras from a common source which was probably in the west, as shown by the number of Himalayan Primula sections found on them. It could not, however, be overlooked that the similarity of flora extended well into China, and for this reason I suggested an old Sino-Himalayan range of which two broken portions now remain, separated by a great gap; also that the advance of the ice in Western China had driven

the western, with perhaps some admixture of North American, forms westwards towards this gap, through which it had flowed southwards in company with the Himalayan flora; and to this mingling of the floras, together with a good climate, warmth, and rainfall, I chiefly ascribe the great wealth of flora along the Burma-Yunnan frontier and the rejuvenescence of Primula life there. There is every reason to believe that the line of Primula migration was not across Burma to Yunnan, but across S.E. Tibet, and it is on this foundation-stone that I have built. Finally, I have suggested that there is a remnant of the Sino-Himalayan range, now severed by erosion from the Himalayas, left in the gap, and that its flora will prove a real link between those of the Himalayas and Western China. This remnant, which it is my greatest ambition to explore, I place to the south of the Salween sources in an unknown part of Tibet.

The foregoing is a rough working hypothesis to account for such facts as have impressed themselves upon me; but it is only with the object of furthering the investigation, in however small a degree, that I have ventured to put such imperfect notes in writing. Certainly the first criticism of every botanist will be something like this: "Yes, but we would like you to cite the distribution of, say, one hundred plants and show how that distribution agrees with the theory"; or perhaps: "Can you cite a reasonable number of Himalayan plants and show that they are found on the parallel divides, and a reasonable number which are found in your North China area, left behind by the ice—for all would not have been driven back by the ice—and a reasonable number of American species also driven on to the parallel divides? For without this last, what proof is there that the eastern flora has ever driven back into the gap, by which means alone could it have travelled southwards? And if the two, eastern and western, floras did not travel southwards in company, does not the whole theory fail?"

These seem obvious criticisms, and I must confess to being unable to cite individual plants which will prove or disprove the theory for the present. But at least I believe the arguments to be not illogical, while they indicate in which direction further research on the problem of the Sino-Himalayan flora is likely to be profitable.

Notes on the Flora of the Orkney Isles.

By Arthur Bennett, A.L.S.

(Read 9th December 1915.)

Mr. Magnus Spence's Flora Orcadensis has brought together the numerous papers on this interesting group, lying as they do between the Shetlands and the mainland of Scotland. A glance through this Flora suggests the following notes:

The number of species listed for the Orkneys seems to hold a middle place between those for Shetland and Caithness. The Orkneys have about 84 species not found in Shetland, and 27 not found in Caithness; while Shetland has 40, and Caithness 118 not found in Orkney

Compared by area, Orkney has 510 square miles, Shetland 325, and Caithness 712.

I have appended a star to plants not included in Mr. Spence's list, but there are several species given in the old lists that cannot be accepted unless refound, while others are obvious errors.

Ranunculus bulbosus, Linn. is a rare species in Orkney, but other stations are given by Col. Johnston in the Scottish Annals.

R. arvensis, Linn.—Given for Orkney in Top. Botany, 15 (1883).

A curious absentee is *Trollius europaeus*, Linn., which occurs both in Caithness and Shetland.

**Fumaria confusa*, Jord.—Locally frequent in cornfields above the N.W. end of Loch Stennis, Mainland. 16th July 1900. Rev. E. S. Marshall sp. named by Mr. Pugsley.

**F. Bastardi*, Bor.—Mainland. E. S. Marshall, No. 2415. Pugsley, Supp. Journ. Bot., 1913.

**F. capreolata*, Linn., var. *Babingtonii*, Pugsley.—Birsay, Trail, 1888. "Nearer *speciosa* than *pallidiflora*," Pugsley, *l.c.*

F. purpurea, Pugsley.—Cornfields above Loch Stennis, Mainland. E. S. Marshall, 1900.

**F. densiflora*, DC. — Mainland. Trail in Scottish Naturalist, 1889, 112.

Subularia aquatica, Linn., and *Viola canina*, Linn., are

both unrecorded; they occur in Shetland!, Caithness!, and O. Hebrides!.

**Viola derelicta*, Jord.—Orkney, Stromness. Marshall, Suppl. Journ. Bot., 1909, p. 21.

Arenaria trinervia, Linn.—A remarkable absentee.

**Ononis repens*, Linn.—Mainland. Trail, 1888.

Hypericum pulchrum, Linn., var. *decumbens*, Rostrup.—Stromness and Sandwick. E. S. Marshall, 1900.

Lupinus nootkatensis, Donn. — Heath, Feavel, Sandwick, 1883. Trail. "Escaped from a cottage garden more than twenty years ago." Found on "brecks," *i.e.* heath with top spit pared off. H. H. Johnston in Bot. Exch. Club Rep. for 1886, p. 146 (1887).

Trifolium hybridum, Linn.—Sandy island. A Somerville cat., 1898.

T. agrarium, Linn.—Mainland. H. H. Johnston, 1912.

Vicia sepium, Linn., var. *montana*, Koch.—The authority for this is Babington, Man., ed. i, 80, 1843. "*V. angustifolia*, Koch (1840) = *V. montana*, Froelich in litt."

Alchemilla alpina, Linn.—Not found; in Caithness!, O. Hebrides!, and Shetland!.

A. alpestris, Schmidt.—Sandy island. Somerville cat., 1898.

A. pratensis, Schmidt.—Salmon in Journ. Bot., 1914, 289.

**Potentilla procumbens*, Sibth.—Mainland, 1888. Trail!.

**Geum intermedium*, Ehrh.—Gillies herb. Watson, Top. Bot., 1883, 130.

Callitriche polymorpha, Lonnr.—Mr Spence tells me he is afraid "he made a too hasty decision respecting this."

The record of *Sison Amomum* is a mistake. Col. Johnston writes: "The plant is *Levisticum officinale*, Koch. This may have been introduced by being used in veterinary practice."

Epilobium ligulatum, Baker.—Mainland. Trail!, 1888.

E. hirsutum, Linn.—Mainland. Trail, 1888.

**Hieracium sarcophyllum*, Stenstr., var. *expallidiforme*, Dahlst.—Orkney. Trail in Ann. Scot. Nat. Hist., 1906, 97.

**H. Orarium*, Lindeb.—Orkney. Trail, *l.c.*

**H. anglicum*, Fr., var. *cerinthiforme*, Backh.—Orkney. Trail, *l.c.*

H. strictum, Fr.—Hobbister rocks, Orphir. Syme.

Sedum acre, Linn. — S. Ronaldshay. Sandy island. A. Somerville cat., 1898.

Pimpinella Saxifraga, Linn.—Picaquoy, 1849. R. Heddle herb. t. Johnston. Heathy hillside, 320 ft. alt. Hoy, 1912. H. H. Johnston.

Cirsium arvense, Scop., var. *horridum*, Koch.—Above Free Church Manse at Orphir. Syme in Bot. Exch. Club Rep. 1872–4, 27.

Carduus arvensis, Robs., var. *setosus* = *Cirsium setosum*, M. Bieb. –Birsay, Orkney. Trail sp., August 1888.

**Arctium minus*, Bernh.—Sandy island. A. Somerville cat., 1898.

Campanula rotundifolia, Linn. -This is the only county it is not recorded for in the British Isles.

Arctostaphylos alpina, Spreng—Hoy. Fortescue, Exch. Club Rep. for 1882, 75 (1884).

Pyrola rotundifolia, Linn.—Rousay. Miss G. Gold, 1869. Ann. Scot. Nat. Hist., 1904, 252.

Primula scotica, Hook.—Introduced to N. Ronaldshay by Dr Trail. Fortescue in Scot. Nat., 1881–2, 375.

**Euphrasia latifolia*, Pursh.—Orkney. Marshall, 1901.

**E. nemorosa*, Mart.—Moul Head, Deerness, 1884. W. I. Fortescue sp.

**Rhinanthus rusticulus*, Druce —South side of Loch Stennis, Mainland. Shoolbred and Williams. Marshall, Journ. Bot., 1903, 295.

Scrophularia nodosa, Linn —Remote glen in Hoy, June 1914 Col. Johnston in litt.

**Atriplex littoralis*, Linn.—Mainland, Orkney. Trail, 1888 !.

**Rumex conspersus*, Hartm. (*R. domesticus* × *obtusifolius*).—Given for Orkney by Syme in Top. Bot., 358.

The Orkney specimens I have seen of *R. obtusifolius*, Linn., fall under *R. Friesii*, Gren. et Godr.

R. pratensis, M. et K.—Swanbister and Gear, Orphir. Syme.

I have seen no Orkney specimen of the Shetland × *R. propinquus*, J. E. Aresch. = *R. domesticus* × *crispus*. It occurs on Fair Isle, between the Orkneys and Shetland. Straker sp.

R. crispus, Linn, var. *granulatus*.—Swanbister, 1873. Syme sp.

**Betula glutinosa*, Fr.—Orkney. Syme in Top. Bot., 372.

**Pinus sylvestris*, Linn.—Orkney in post-glacial deposits. Niven in Rep. Brit. Assoc., 1901, 840.

The record of *Ceratophyllum demersum*, for Loch of Ayre, Kirbister, is an error of Heddle's, his plant being *Utricularia vulgaris*, as shown by the specimen in Col. Johnston's herbarium. *U. vulgaris* was recorded in Top. Bot., ed. i., 1874, 319, by Boswell.

**Potamogeton interruptus*, Kit.—Loch of Stennis, 1888. Trail sp., and E. F. Linton sp.

P. pectinatus, Linn.—Kirbister Loch. Syme sp., 1888.

P. marinus, Linn. = *P. filiformis*, Nolte !.—Loch of Birsay and Burn of Hundland. Syme sp. Swanbister, 1852. E. F. Bennett sp.

P. pusillus, Linn.—Loch of Kirbister, Orphir, 1878. W. I. Fortescue sp.

P. heterophyllus, Schreb.—Loch of Harray, Orkney, 1852. W. I. Fortescue sp. A form of the species closely simulating twenty-one American specimens. Peduncles 6 inches long, upper floating leaves 1 inch × 3/8 inch

P. lucens, Linn.—Muckle Water, Rousay, 1890. W. I. Fortescue sp. A large-leaved form simulating *P. longifolius*, Gay, but wanting the strict even-sided leaves of that plant and the dark colour Leaves up to 10–11 inches by 1¼ inches wide, acute-acuminate, with wavy margins. The only specimens I have seen to approach it are from Siberia. Dr. Augustinowicz.

**Zannichellia palustris*, Linn.—Kirbister Loch, 1850. Syme.

Juncus biglumis, Linn, p. 78—Must be an error; no authority given, and I can find no record.

J. triglumis, Linn.—This appears to be an addition to the Flora. It occurs in Shetland !, but not in the O. Hebrides.

J. compressus, Jacq.—Neill's record of this would have little weight. Syme knew the plant, yet said he had only seen it in Watson's station in Surrey. *J. compressus* is rare in Scotland. Dumfries, Kirkcudbright, Edinburgh, and Dumbarton are the only counties from which I have seen it.

Luzula pilosa, Willd.—"Not reported for many years,"

p. 79. It seems strange that so common a species has been overlooked. Still both in Shetland and Caithness. *L. sylvatica* seems to be the commoner species.

Carex limosa, Linn., p. 84—Another new record for the Isles in the Flora.

Carex Oederi, var. *oedocarpa*, And.—Marsh near N. Dam, Hoy, 1886. Stony loch shore, Loch of Kirbister, 1913. H. H. Johnston.

**Koeleria cristata*, Linn., sub-sq. *britannica*, Dom.—Orkneys. E. S. Marshall, Ann. Scot. Nat. Hist., 1906, 32.

Festuca bromoides, Linn.—Shell sand and shingle in Bay of Skail, Mainland, 1913. H. H. Johnston.

Lastrea dilatata, Presl., var *collina*, Moore.—Trail in Ann Scot. Nat. Hist., 1907, 229.

Equisetum palustre, Linn. var. *nudum*, Newn.—Trail, *l.c.*, 230.

**Isoetes lacustris*, Linn. -Hill lake, Peerie Water, Rousay, 1901. A. Somerville sp. Reported but not accepted by Mr. Spence.

Ophioglossum vulgatum, Linn., var. *ambiguum*, Coss. et Germ.—This was discovered by Mr. W. I. Fortescue, 2nd August 1878, on the west end of the Calf of Flotta. Black Craig, Stromness. Miss P. Deuche in Exch. Club Rep., 1877–8, 20 (1879). Veness, Swanbister. Syme.

**Chara fragilis*, Desv., var. *capillacea*, Coss. et Germ.—Rotten Loch, Brims, Waas, Hoy Col. Johnston in Trans Edin. Bot. Soc., xxvi, 226 (1894).

**Chara aspera*, Willd., var. *desmacantha*, H. et J. Groves. —Orkney. Ann. Scot. Nat. Hist., 1907, 230.

C. baltica, Fr.- This was found by Messrs. Marshall and Shoolbred, 13th July 1900; and by Mr. Crawford, 31st August 1900.

At pages 138–9 is a "Note on a New Primula found in Orkney by Mr. M. Spence," by C. E. Moss, D.Sc., F.L.S., F R.G.S.

Plants grown by Mr. Hunnybun "had capsules 1·5 to 2·0 times as long as the calyx; with narrow, less compact, more spathulate, and more obtuse leaves." Then Dr. Moss finds that Mr. Spence's plant verges towards *P. stricta*, Fries, a Scandinavian species, and *perhaps is actually that species*. There is certainly no climatic reason against

stricta as a Scottish species; but an examination of fifty-two specimens of *scotica*, among them a third from Orkney, from Mr. Spence, and a specimen of the variety itself, hardly sustains the idea of *stricta*.

Twice the length of the calyx is certainly very unusual, but half as long again occurs in many; and *stricta* is a taller, more gracile species, with the leaves "subtus nudiusculis," not "subtus farinosis," as in *scotica*. It seems to be better to adopt Dr. Moss's name of var. *orkniensis* for the plant.

To the bibliography should be added Low's list of Orkney plants in Barry's History:—

1. A second edition in 1808, by Rev. J. Hendrick.
2. Another in 1813, edited by W. E. Leach.
3. Syme in Bot. Soc. Edin. iv, 47–50 (1850).
4. Col. Johnston in Trans. Bot. Soc Edin., xxvi, 207–226 (1914).

There are still about fifty species reported in various lists, etc, that have not been confirmed, and are probably mostly errors.

Periodicity in Transpiration. By Sophie J. Wilkie, B.Sc. (Two figures.)

(Read 14th October 1915.)

Periodicity in transpiration has been recorded by various research workers, and the evidences up to 1904 have been collected by Burgerstein in his monograph Die Transpiration der Pflanzen (Jena, Verlag von Gustav Fischer, 1904) A daily maximum has been obtained, and was found to occur any time between the hours of 9 a.m. and 3 p.m., varying with the different species of twigs experimented upon.

Unger (Sitzb. d. k. Akad. der Wissensch. Wien, Bd. xliv, 1862, pp. 181–327) was the first to accept this periodicity, but his experiments were not performed under constant conditions.

Sachs (Landw. Vers. Stationem, Bd. i, 1859, p. 203) believed in the rhythm of transpiration on analogy with growth periodicity

Sorauer (Forsch. a. d. Gebiet der Agrikultur Physik von Wollny, Bd. iii, 1880, p. 351) observed a maximum of transpiration in the late forenoon and early afternoon, and a minimum before sunset.

Baranetzky (Bot. Zeitung, tom. xxx, 1872, p. 65) denies the existence of a periodicity, and is of the opinion that the plants transpire more during the night than in the daytime, mentioning that the loss of water is steady but not periodic.

Eberdt contradicts Baranetzky's views from the results of his own experimental work.

More recent research on periodicity in transpiration has been carried out by C. C. Curtis (Bull Torrey Club, tom. xxix, 1902, p. 363). Curtis took weighings every hour for a period extending over twelve hours or less, and the temperature and humidity of the laboratory were kept as constant as possible. He obtained a maximal value for transpiration about the middle of the day, and minor fluctuations independent of the light intensity were also recorded. Experiments were performed under normal conditions in constant illumination and in the dark. He found that the curve in the dark sometimes was in keeping with that obtained under constant illumination, but it was more often very erratic. The graphs obtained by Curtis for transpiration resembled Sachs' curve for growth, Vesque's curve of absorption, and Detmer's curve for the periodicity of exudation of fluids from cut stems and fluid tensions. The transpiration graphs obtained by Curtis varied for every plant experimented upon, and for the same plant no two graphs were ever alike.

In order to have more positive proof of the phenomenon of periodicity, it was necessary to procure graphs of at least twenty-four hours' duration, and for this purpose the apparatus already described at the June meeting of the Society, 1915, was used.[1]

The plants experimented upon were

1. *Pinus sylvestris.*
2. *Opuntia occidentalis.*
3. *Lilium rubrum.*

[1] See Trans. Bot. Soc. Edin., xxvi (1915), 432.

In every case records continuing over several days were obtained, and as far as possible they were uninterrupted. The temperature was kept as constant as possible, the variation being from 2° to 4°. The percentage humidity was on an average between 60 and 70.

A. *Normal Conditions of Light and Dark.*

1. *Pinus sylvestris.*

(1) 11th June to 23rd June 1914.

The natural conditions at that time were approximately sixteen hours' light to eight hours' darkness. Transpiration was found to be more active during the light than during the darkness period, the ratio being as 1 : ·32, while the ratio of light to dark is as 1 : ·5

An analysis of the hourly graph shows that at this season there is on an average a maximum of transpiration at 4 o'clock in the afternoon, a minimum at 3 o'clock in the morning.

(2) 25th November to 18th December 1914.

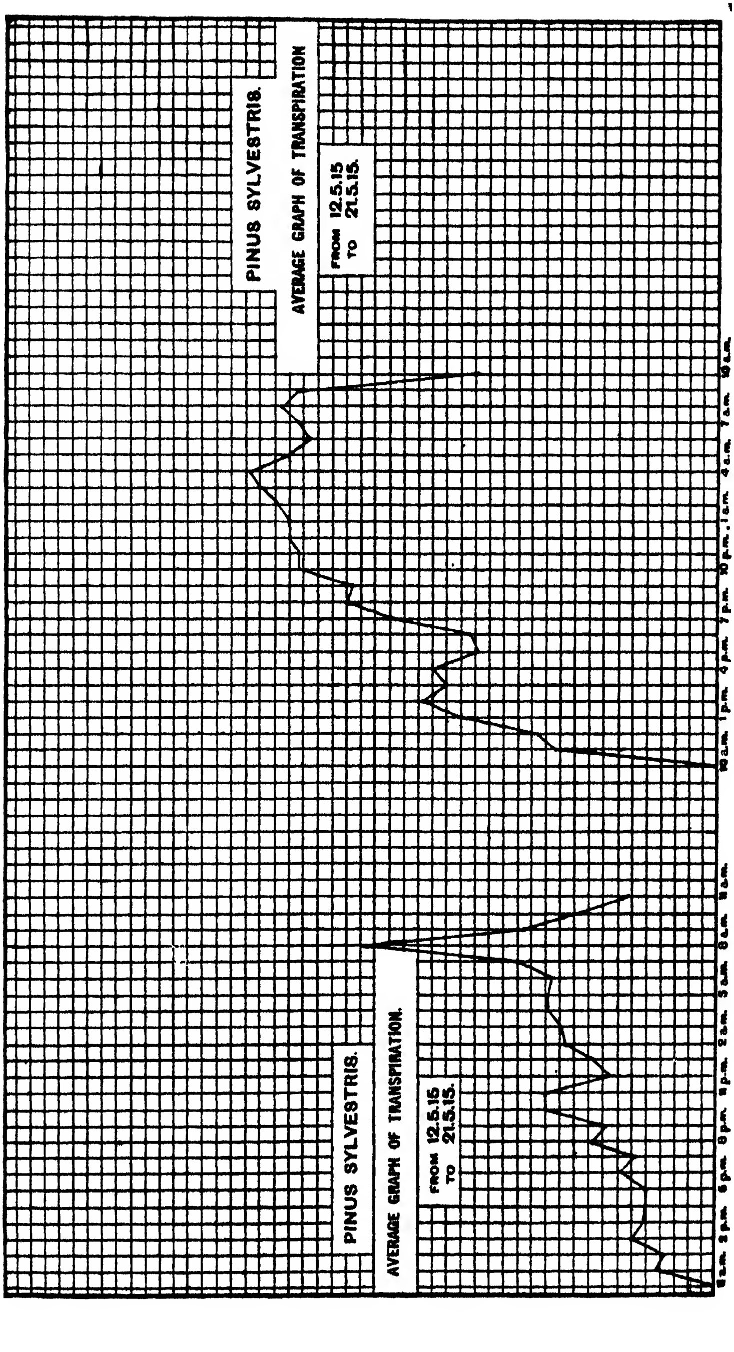
The conditions as regards the illumination of the plant at this time were eight hours' light to sixteen hours' darkness—just the exact reverse of the state of affairs in June. In this case the average mean ratio of transpiration in light to transpiration in the dark is 1 : 2·9, while the ratio of light to dark is as 1 : 2.

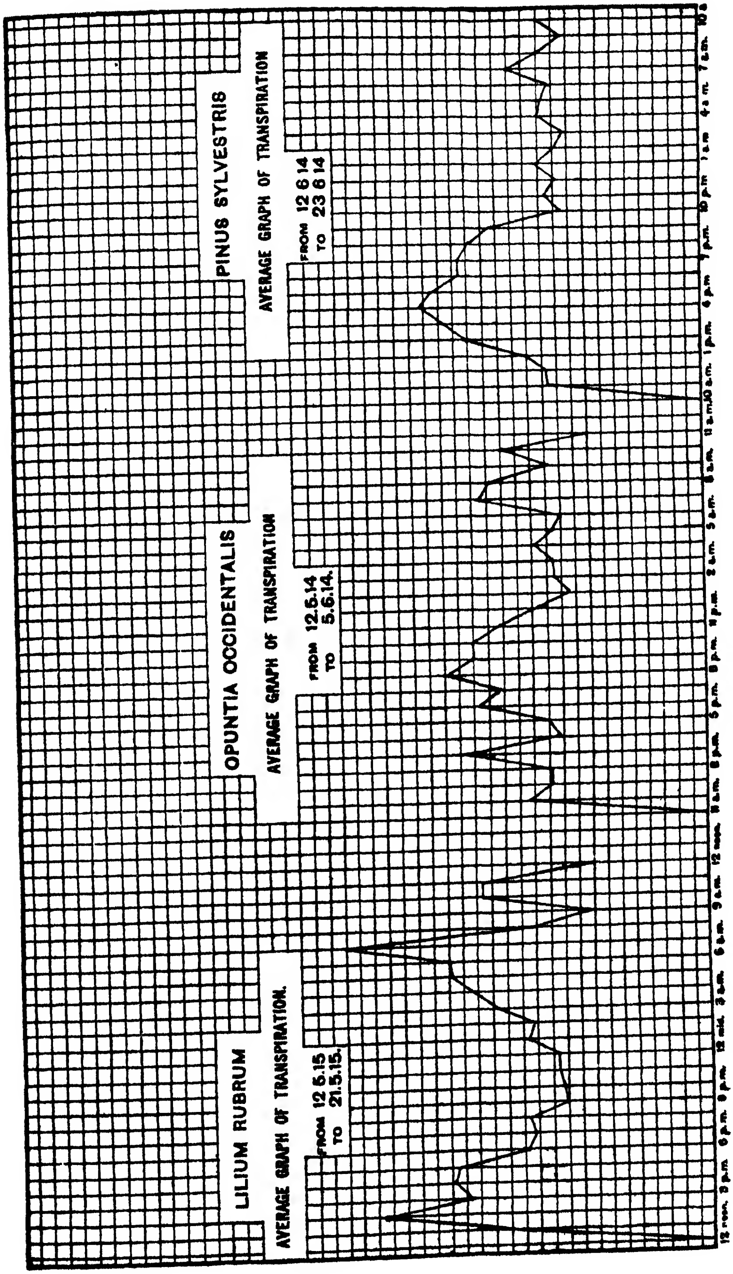
The hourly graphs show as an average a maximum at 4 o'clock in the morning, a minimum at 5 p.m.

(3) 19th January to 19th February 1915.

In this case the ratio of light to dark is for January as 1 : 2, and for February as 1 : 1·4. Here again the figures show transpiration during the period of darkness to be greater than that of light, although the difference is not so marked as in the November-December records; the ratio of transpiration in light to that in dark is as 1 : 1·5.

The maximal value of transpiration at this time as seen from the average graph occurs at 8 o'clock in the morning. The minimal values are very variable, but approximately there is a minimum at 1 p.m.


PINUS SYLVESTRIS.
AVERAGE GRAPH OF TRANSPIRATION
FROM 12.5.15
TO 21.5.15.
PINUS SYLVESTRIS.
AVERAGE GRAPH OF TRANSPIRATION.
FROM 12.5.15
TO 21.5.15.


PINUS SYLVESTRIS
AVERAGE GRAPH OF TRANSPIRATION
FROM 12 6 14
TO 23 6 14
OPUNTIA OCCIDENTALIS
AVERAGE GRAPH OF TRANSPIRATION
FROM 12.5.14
TO 5.6.14.
LILIUM RUBRUM
AVERAGE GRAPH OF TRANSPIRATION.
FROM 12 5.15
TO 21.5.15.

2. *Opuntia occidentalis.*

12th May to 4th June 1914.

The natural conditions were, at this time, sixteen hours' light to eight hours' darkness. *Opuntia occidentalis* transpires considerably during the darkness period—the ratio of transpiration in light to that in dark being as 1 : ·37, while the ratio of light to dark is as 1 : ·5. The hourly graphs show on an average a maximum of transpiration at 8 p.m., a minimum at 4 p.m., with subminimum at 1 a.m.

3. *Lilium rubrum.*

1st May to 21st May 1915.

The plant at this period would be subjected to sixteen hours' light and eight hours' darkness. The hourly graphs show that the maximal values of transpiration occur at 7 o'clock in the morning and 2 o'clock in the afternoon, the minimal values at 9 p.m. and 9 a.m. The ratio of transpiration in the light to transpiration in the dark is on an average as 1 : ·22.

B. *The Effect of Darkness on Transpiration.*

The types *Pinus sylvestris* and *Lilium rubrum* were experimented upon in the dark room, and in both cases the transpiration was found to be very erratic. In spite of the absence of light, transpiration was very active, and there was evidence of a periodicity, although it was very variable.

Summary.

1. Under normal conditions there is a daily periodicity in transpiration.

2. This periodicity varies in the three types experimented upon.

3. Under all dark conditions transpiration is active but erratic.

I have to thank Mr. R. A. Robertson for his kind assistance in the arranging of these results.

Saxifrages of the Diptera Section, with Description of New Species. By Professor Bayley Balfour, F.R.S.

(Read 7th October 1914.)

The Diptera Saxifrages—we know something of fourteen species—form a compact group marked by peculiar distinctive characters of flower and fruit.

Those of the corolla are the most striking. The petals are unequal. The anterior petal is always the longest and from a shortly clawed base elongates to strap-shaped form and appears like a wing hanging from the front of the flower which is usually placed on the inflorescence with its axis horizontal. This anterior petal is persistent and enlarges during fruiting, becoming at the same time somewhat stiff. One of the antero-lateral petals, that towards the left, is sometimes similarly enlarged, the enlargement being equal in amount, or perhaps more often slightly less. The other petals are also unguiculate but are much smaller, sometimes not a fifth the length of the larger one or ones, and they fall off early. The petals all have a white ground-colour—save in *S. Henryi*, Balf. fil. in which Henry says the flowers are red—and the long petals do not show much blotching; that is reserved for the smaller petals in several species where they are yellow and red-spotted. The flowers in these Saxifrages are then irregular, and it is the presence of these long petals hanging in front of the flower that gave Borkhausen his generic name.

In one species, *S. cuscutaeformis*, Lodd., the petals have been described and indeed figured as having all the elongated form characteristic of one or two petals in other species. In the plants of this species which have flowered at Edinburgh this equality of petals occasionally appears; as a rule the flowers show only slight divergence towards equality.

The large yellow disk is a marked feature in the Section and requires further examination in fresh material of several species. In some—for instance, *S. sarmentosa*, Linn. fil., *S. cuscutaeformis*, Lodd., *S. Veitchiana*, Balf. fil.—the disk

is unilateral, filling the space between the three small petals and the ovary which it embraces. Its median is therefore opposite the gap between the two petals which are or may be enlarged. It increases the irregularity of the flower and is an evident feature, covered as it is by more or less prominent tubercles. In all the other species—so far as I have been able to examine them for the character—the disk is circular and completely encircles the ovary, at the same time showing a smooth surface with at times faint evidence of tuberculation. How far the character of the disk can be used for specific distinction and grouping, investigation will show.

The fruit character of the Diptera Saxifrages is one of much interest to students of adaptations. As the gynaeceum enlarges the pedicel at a point immediately below the torus shows curvature and always in direction towards the posterior side of the flower. The curvature proceeds until the developing fruit becomes inverted with one septal surface closely adpressed to the pedicel. This curvature brings at the same time the large anterior petal, which has been enlarging and stiffening, from its downwardly directed position as a hanging flag in the flower into an erect or nearly erect position on the curved end of the pedicel and above the upward turned base of the fruit. We get then a capsule with mouth directed downwards—the mouth being a transverse slit between the styles, the size of which can be regulated by the degree of drying of the style-bases-surmounted by an erect stiff strap-shaped petal one or more centimeters long. There may be two such petals. The mechanism may be interpreted in terms of seed-distribution, and the suggestion is an obvious one that the petal, exposing a surface to currents of air, is the agent through which vibration is communicated to the stiff thread-like pedicel below, and the seeds protected from wet in an inverted capsule are shaken out easily from the downwardly directed capsule mouth.

The Diptera Saxifrages are all Japanese or Chinese—China claiming nine, and Japan five. One of the Japanese species—*S. sarmentosa*, Linn. fil.—has been sent in dried specimen from China, but it is a doubtful native.

SAXIFRAGES OF THE DIPTERA SECTION.

S. aculeata, Balf. fil. Sp. nov. China.
S. cortusaefolia, Sieb. et Zucc. Fl. Jap. Fam. Nat. in Acad. Muench., iv, 11 (1843), 190; Bot. Mag., t. 6680. Japan. Cult. Introd. before 1874, Veitch. Coll. Maries; or Fortune and Standish.
S. cuscutaeformis, Lodd., Bot. Cab., t. 186 China? Cult. Introd. before 1815. Loddige.
S. dumetorum, Balf. fil. Sp. nov. China.
S. flabellifolia, Franch. (non R. Brown) in Morot, Journ. Bot., viii (1894), 295. China.
S. Fortunei, Hook. in Bot. Mag., t. 5377. Japan. Cult. Introd. about 1863, Standish. Coll. Fortune.
S. geifolia, Balf. fil. Sp. nov. China.
S. Henryi, Balf. fil. Sp. nov. China.
S. imparilis, Balf. fil. Sp. nov. China.
S. madida (Maxim.), Makino in Tokyo Bot Mag, vi (1892), 52; Yatabe Icon. Fl. Jap., i, 11, pl. vii. Japan. Cult.
S. rufescens, Balf. fil. Sp. nov. China. Cult Introd. 1908, Bees. Coll. Forrest.
S. sarmentosa, Linn. fil. Suppl. 240; Bot. Mag., t. 92. Japan. Cult. Introd. before 1771.
S. sendaica, Maxim., Mel. Biol., viii (1872), 601; So Moko Zusetz., viii, t 16. Japan.
S. Veitchiana, Balf. fil. Sp. nov. China Cult Introd. about 1904, Veitch. Coll. Wilson.

Of the fourteen, three of the Chinese (*S. cuscutaeformis*, Lodd., *S. rufescens*, Balf. fil., and *S. Veitchiana*, Balf. fil.), and four of the Japanese (*S. cortusaefolia*, Sieb. et Zucc., *S. Fortunei*, Hook., *S. madida*, Makino, *S. sarmentosa*, Linn. fil.) are in cultivation.

The longest and perhaps the best known species is *S. sarmentosa*, Linn. fil—the so-called Strawberry Saxifrage, and bearing also several other names: Wandering Jew, Aaron's Beard, Old Man's Beard, Mother of Thousands, Sailor Plant,—familiar to everyone in its white-veined hairy leaves and long runners—the flower with a large yellow one-sided tubercled disk. Cultivated in the East as in the West, it has probably spread from Japan to China where it is found in isolated areas always apparently about large cities. Its variety *tricolor* is a striking well-known greenhouse plant.

S. cuscutaeformis, Lodd., is another plant of cultivation. Its wild habitat is unknown. There is no record of it in the careful account of their Flora by Japanese botanists and it is assumed to be a Chinese plant. It may be regarded as a minute *S. sarmentosa*, Linn. fil., the leaves

very small and not hairy, the flower scapes only a few inches high. The flowers are pure white.

A few years ago Messrs. Veitch sent out under the name of *S. cortusaefolia* one of Wilson's Chinese plants, and a delightful one it is, forming long runners and rapidly making a leaf carpet. It is not *S. cortusaefolia*, Sieb. et Zucc. which is apparently only Japanese. I have named it *S. Veitchiana*. It has orbicular green leaves and small flower panicles and can at once be recognised from *S. cortusaefolia* by its flagella—there are none in *S. cortusaefolia* —and by the unilateral yellow tuberculate disk in the flower —it is circular and smooth in *S. cortusaefolia*. From *S. sarmentosa*, Linn. fil. its bright green leaves, not white-veined, and small inflorescences distinguish it. Occasionally the leaves of the young rooting rosettes on the runners show some white veining.

S. cortusaefolia, Sieb. et Zucc. (*S. japonica* of old gardens) is one of the species which do not form runners. It is widely spread in Japan. Two stories of its introduction are current: one that it came to Britain through Maries, collector for Messrs. Veitch, about the middle of last century; the other that Fortune and Standish introduced it. It was in cultivation before 1874. The stiff fleshy leaves and pure white flowers make it an effective plant, but at Edinburgh not quite satisfactory outside. It is variable. Makino's varietal names *obtusocrenata* and *partita* refer to features of the leaf, and *S. madida*, Makino, is a microform with more delicate leaves more deeply cut.

The palm for beauty belongs to the Japanese *S. Fortunei*. Hook., discovered by Fortune, and known in our gardens for some sixty years. Its fringed rich green leaves, the largest of all in cultivation, with bronzed or bright red underside and petiole, and its large white flowers, make it a welcome plant. Like *S. cortusaefolia*, Sieb. et Zucc. it does not show its best foliage in the open at Edinburgh and its flowers come too late for so succulent a plant in the Edinburgh climate.

S. rufescens, Balf. fil. is the most recent introduction of the group, and is from China. It has come from Bees, Ltd. through their collector G. Forrest. It is a plant of the habit of *S. cortusaefolia*, Sieb. et Zucc., but distinguished

by the densely red-hairy flower-shoots and the petals flushed with red. It is hardy at Edinburgh, and, flowering in July, escapes the mischance to which the late-flowering *S. Fortunei*, Hook. and *S. cortusaefolia*, Sieb. et Zucc. are liable.

Of the other known species not yet introduced there are the Japanese *S. sendaica*, Maxim., an erect grower, with palmatifid cuneate-based leaves and without runners; this character is shared by the Chinese *S. flabellifolia*, Franch. and *S. imparilis*, Balf. fil., both of which resemble *S. cortusaefolia*, Sieb. et Zucc., but differ—the former in its truncate or cuneate leaf-bases, the latter in its truncately topped fruit. *S. geifolia*, Balf. fil. and *S. dumetorum*, Balf. fil. are trailing Chinese species with flagella and leaves the shape of which recalls that of our native *S. Geum*, Linn. The former has copiously branched panicles of small flowers, the latter has inflorescences bearing few branches, and it also has white blotches on the upper leaf surface.

Not one of the unintroduced species noted above gives promise of gardening value, unless perhaps *S. geifolia*, Balf. fil.

It is otherwise with the plant I have named, *S. Henryi*, Balf. fil. This, one of Henry's finds in the neighbourhood of Szemao, is peculiar in the section, having oblique peltate leaves like a begonia, and whilst the upper surface is grey of hue, the under is of a rich purple with darker purple dots all over it. The margins, too, are somewhat prickly. Henry says the flowers are red. For the foliage alone the plant should be worth having—the red flowers add an attraction. Coming from Szemao its hardiness is open to suspicion.

From Szemao comes also another of Henry's finds, *S. aculeata*, Balf. fil., a form evidently nearly allied to *S. Henryi*, Balf. fil. but not showing the brilliant colouring of the leaves, which are here symmetric and develop upon their margins a series of more pronounced prickles. The colour of flowers is not recorded but in the dried plant these have all the features shown by *S. Henryi*, Balf. fil., and may be red as in that species.

That we are to regard as fixed characters the presence or absence of the white veining of the leaf appearing in species of the flagelliferous series is by no means certain.

Thus *S. Veitchiana*, Balf. fil. normally has concolorous leaves, but occasionally young rosettes on the runners show a faint white veining. Again, *S. sarmentosa*, Linn. fil. in certain conditions may have some of its leaves concolorous instead of white-veined; and then there is the var. *tricolor* of *S. sarmentosa*, Linn. fil., with its uncertain blotching. Some experiments begun a few years ago for the purpose of obtaining evidence have been interrupted, but the subject is one deserving investigation. It may show that some of the species are really growth forms of one.

One may group the species in the following key:—

FLAGELLIFEROUS.

Lamina white-veined above. Toral disk unilateral:	
Lamina hairy above	*sarmentosa*
Lamina glabrous above	*cuscutaeformis*
Lamina white-blotched above. Toral disk circular	*dumetorum*
Lamina concolorous above:	
Toral disk unilateral	*Veitchiana*
Toral disk circular	*geifolia*

NON-FLAGELLIFEROUS.

Leaves prickly at margin:	
Leaves peltate	*Henryi*
Leaves not peltate	*aculeata*
Leaves not prickly at margin:	
Leaves palmatifid, lamina cuneate at base	*sendaica*
Leaves reniform orbicular:	
Lamina cuneate or truncate at base	*flabellifolia*
Lamina with basal sinus:	
Lamina bronzed beneath	*Fortunei*
Lamina grey green beneath:	
Flower stems densely red hirsute	*rufescens*
Flower stems more or less pilose:	
Capsule truncate	*imparilis*
Capsule with semi-erect style:	
Leaves thick, fleshy	*cortusaefolia*
Leaves thin, deeply cut	*madida*

I add here technical descriptions of the new species of which I have spoken in the preceding pages, namely:—*Saxifraga aculeata*, Balf. fil., *S. dumetorum*, Balf. fil., *S. geifolia*, Balf. fil., *S. Henryi*, Balf. fil., *S. imparilis*, Balf. fil., *S. rufescens*, Balf. fil., *S. Veitchiana*, Balf. fil.

Saxifraga aculeata, Balf fil.

Planta eflagellifera radicibus fibrosis foliis petiolatis. Folia ad 12 cm. longa; lamina ovata aequilateralis coriacea apice acuta basi cordata sinu clauso, margine cartilaginea

leviter acute dentato-lobata setis aculeatis ciliata, utrinque glauca supra glabra infra maculis rotundis stomatalibus picta: petiolus lamina vix longior setosus basi vaginatus ibique pilis setiformibus rufidulis dense obtectus. Inflorescentia brevis ad 16 cm. alta pauciflora. Caulis et rami (4–5) graciles sparsim rufo-pilosi; bracteae lineares submembranaceae inferiores 2–3 steriles; pedicelli filiformes. Florum forma et color forsan ut in *S. Henryi*, Balf. fil.

Species *S. Henryi*, Balf. fil. verosimilis sed foliis omnibus aequilateralibus non peltatis utrinque concoloribus diversa.

Yunnan:—Mengtz. Cliffs, 5000 ft. Henry. No. 10,316 B.

Saxifraga dumetorum, Balf. fil.

Herba pilosa saepe rufescens flagellifera, flagellis filiformibus plus minusve pubescentibus cataphylla gerentibus. Folia ad 8 cm. longa; lamina cordato-orbicularis vel subreniformis sinu fere clauso ad 2·5 cm. diam. plerumque minor leviter crenato- vel dentato-lobata, lobis verrucula hydathodali marginali instructis, margine ecartilaginea hirsuto-ciliata, utrinque in foliis juvenilibus dense (in adultis sparsim) setoso-pilosa supra viridis albo-maculata subtus areolis stomatalibus rubro-maculata: petiolus laminam longe superans basi vaginatus dense hirsutus. Inflorescentia ad 20 cm. alta; caulis pilis rufis obtectus in triente supremo ramosus, infra cataphylla sterilia tria linearia gerens. Rami pauci breves vix 1 cm. longi 2–3-flori; bracteae breves lineares rufoglandulosae; pedicelli brevissimi. Sepala minuta 2 mm. longa ovato-oblonga glanduloso-pubescentia trinervia nervis sub apice in hydathodum confluentibus. Petala albida inaequalia, majora ligulata acuta ad 1 cm. longa ad 4 mm. lata penninervia venis adscendentibus, minora plerumque quatuor ad 2·5 mm. longa ovata acuta uninervia. Staminum filamenta subclavata. Ovarium parvum disco circulari etuberculato cinctum.

Ex affinitate *S. Veitchianae*, Balf. fil., foliis maculatis hirsuto-ciliatis, inflorescentia brevissime ramosa notisque aliis distincta.

Hupeh:—Henry. 1885–88. No. 1129. Herb. Edin.

Yunnan:—Pe-long-tsin. Alt. 9600 ft. On rocks under brushwood. Stoloniferous, tumescent, leaves blood red beneath. E. E. Maire. June. No. 11/1914. Herb. Edin.

Saxifraga geifolia, Balf. fil.

Herba eflagellifera radicibus fibrosis et foliis plurimis basalibus petiolatis. Folia ad 10 cm. longa; lamina cordato-orbicularis ad 4 cm. diam. petiolo multo brevior carnosula grosse crenato-lobata lobis crenulatis, margine cartilaginea et hydathodis corneis obscure denticulata hic et illic ciliata, foliorum juvenilium et adultorum pagina inferior plerumque purpurea maculis stomatalibus punctata, superior glabra vel setis paucis conspersa; petiolus ad 8 cm. longus dense hirsutus basi vix vaginatus. Caulis inflorescentiae tenuis pilosus ad 30 cm. altus apicem versus copiose graciliter ramosus, infra bracteis 2–5 sterilibus parvis linearibus praeditus; rami filiformes 3–6-flori pedicellis ultimis 1 cm. longis strictis patentibus glanduloso-puberulis. Sepala oblonga ·75 mm. longa puberula uninervia hydathodo terminali. Petala inaequalia anterius ligulatum 1·5 cm. longum, ·75 mm. latum, acutum uninerve album, caetera quatuor elliptica minutissime ciliata mucronulata 1·5 mm longa, uninervia basi in unguem attenuata. Staminum filamenta alba anguste clavata, sepalis duplo longiora. Discus luteus parvus circularis ovarium cingens Carpella ad medium stylorum confluentia, styli albi tenues. Fructus deflexus brunneus stylis divergentibus basi ampliatus supra constrictus poro angusto dehiscens.

Species *S. Veitchianae*, Balf. fil. affinis foliis margine cartilagineis et floris disco etuberculato ovarium circumambiente distincta.

Yunnan:—On ledges of cliffs and humus-covered boulders; on the mountains in the north-east of the Yangtze bend. Lat 27 45′ N. Plant of 6-12 inches. Flowers white, foliage succulent. G. Forrest. No 11,438. September 1913.

Saxifraga Henryi, Balf. fil.

Planta radicibus fibrosis foliis petiolatis. Folia ad 20 cm. longa; lamina petiolo brevior peltata inaequilateralis ovata vel ovato-orbicularis carnosa 9-10-lobata margine cartilaginea subdentata aculeato-setosa supra glauca sparsim strigosa subtus purpurea maculis stomatalibus picta; petiolus validus setosus vagina dense ciliata. Inflorescentia ad 40 cm. alta. Caulis pilosus ad medium

nudiflorus cataphylla 3 sterilia gerens, supra multiramosus ramis tenuibus elongatis 3–5-floris bracteis parvis linearibus. Flores rubri (fid. Henry). Sepala 2 mm. longa ovato-lanceolata obtusa puberula trinervia nervis sub apice in hydathodum confluentibus. Petala inaequalia unguiculata, majora 1 vel 2 inaequalia lanceolato-ligulata nervis tribus convergentibus conspicuis pluricostata ad 1·5 cm. longa, minora 4 vel 3 elliptico-oblonga 3 mm longa acuta uninervia. Staminum filamenta vix clavata petalis brevioribus longiora. Ovarium disco leviter corrugato cinctum; styli longi.

Species ab omnibus Sectionis Dipterae foliis peltatis floribusque rubris distincta.

Yunnan:—Mengtz. South-west mountains. 6000 ft. Flowers red. Henry. No 9118.

Saxifraga imparilis, Balf. fil.

Herba rhizomate parvo plus minusve pilosa glabrescens. Folia pauca longe petiolata ad 20 cm. longa; lamina cordato-orbicularis vel subreniformis basi aperta ad 8 cm. diam. 7–11-lobata lobis acute dentatis apice verruculosis. margine eciliata, utrinque glabra. vel supra sparsim strigoso-pilosa; petiolus glaber vel pilosus basi vix vaginatus. Inflorescentia ad 40 cm. alta a medio caulis laxe paniculata infra bracteis 1–2 sterilibus nonnunquam fertilibus trifidis et petiolatis suffulta glabra vel leviter pilosa; bracteae supremae lineares; rami 4–7 tenues patentes saepe biramosi 3–7-flori; pedicelli filiformes stricti pilosi. Sepala 1·5 mm. longa oblonga obtusa puberula uninervia. Petala inaequalia, majora 1–2 linearia acuta ad 8 mm. longa uninervia vel obscure trinervia, minora 4–3 ovata lanceolata acuta sepalis duplo longiora uninervia. Staminum filamenta clavata petala superantia. Discus laevis ovarium cingens. Ovarium pulvinatum: styli breves albi erecti. Fructus deflexus apice latior et subtruncatus ore elongato inter stylos horizontaliter patentes dehiscente.

Species *S. cortusaefoliae*, Sieb. et Zucc. persimilis floribus et fructu bene distincta.

Yunnan:—Mi le district. 6000 ft. on rocks. Henry. No. 9917.

Yunnan:—Rocks of Lore-pou. Alt. 9000 ft. Tomentose. flowers white. E. E. Maire. 15/1914. Herb. Edin.

Saxifraga rufescens, Balf. fil.

S. cortusaefolia, Engler et Irmscher in Notes R.B.G. Edin., v (1912), 128.

Rhizoma tuberosum alabastris et vestigiis foliorum obtectum. Folia petiolata ad 20 cm. longa; lamina cordato-orbicularis vel reniformis ad 10 cm. diam. petiolo brevior sinu aperto vel lobis basalibus imbricatis ad tertiam partem 9–11-lobata lobis inciso-dentatis, margine recurva ecartilaginea pilis rufidulis ciliata, utrinque pilosa vel hirsuta supra viridis subtus glauca; petiolus carnosulus validus ruber pilis plus minusve rufis dense hirsutus basi vaginatus. Inflorescentia ad 45 cm. alta; caulis plus minusve ruber et glanduloso-hirsutus infra nudus a medio ramosus; rami rigidi breves plurimi racemose dispositi ex axillis bractearum linearium parvarum horizontaliter patentes ubique dense rufo- et glanduloso-hirsuti 4–6-flori. Florum alabastra rubra. Sepala 1·5 mm. longa ·5 mm. lata oblonga obtusa erubescentia puberula. Petala albida epunctata sed erubescentia, majora linearia vel anguste lanceolata acuta trinervia ad 1 cm. longa 1–1·5 mm. lata, minora oblonga obtusa mucronulata 3 mm. longa 1·5 mm. lata uninervia Staminum filamenta clavata alba sepala duplo superantia, antheris cinnabarinis. Ovarium globosum disco luteo circulari antice subsulcato cinctum; styli albi breves. Fructus rubescens inter stylos horizontaliter deflexos dehiscens.

Species rhizomate tuberoso et inflorescentia pilis rufis fere nigris glandulosis vestita bene distincta.

Yunnan:—Eastern flank of the Tali range. Lat. 27' 20′ N. Alt. 10,000–11,000 ft. Plant of 6–15 inches. Flowers white, anthers brick red. On moss-covered rocks and banks in shady pine and mixed forests. G. Forrest. No. 2401. June 1906.

Yunnan:—Eastern flank of the Tali range. Lat. 25° 40′ N. Alt. 11,000–12,000 ft. Plant of 9–14 inches. Flowers white, anthers brick red. Moist, shady, and rocky situations in pine and mixed forests. G. Forrest. Nos. 4199, 5059. August 1906.

Yunnan:—Eastern flank of the Lichiang range. Lat. 27° 40′ N. Plant 1–2 ft. Flowers white. Shady situations in and on the margins of mixed and pine forests. G. Forrest. No. 6067. July 1910.

Yunnan:—Eastern flank of the Tali range. Lat. 25° 40′ N. Alt. 10,000–11,000 ft. Plant of 8–16 inches. Flowers creamy white. Shady banks in mixed forests. G. Forrest. No. 6952. 1910.

Yunnan:—Mt. Tahai. Rocks. Alt. 9600 ft. Leaves velvety, ciliate. Flowers white. E. E. Maire.

Saxifraga Veitchiana, Balf. fil.

Flagellifera plus minusve setoso-pilosa. Flagella filiformia cataphyllis instructa rubra sparsin pilosa ramosa. Folia petiolata ad 10 cm. longa: lamina carnosula cordato-rotundata vel reniformis ad 5 cm. diam. petiolo brevior, margine sub-revoluta obsolete late crenulata ciliata, in foliis juvenilibus utrinque setoso-pilosa, in adultis supra viridis glabra infra substrigosa maculis rubris oblongis plurimis stomatalibus punctata: petiolus validus carnosus erubescens setoso-pilosus basi vaginatus. Caulis terminalis erubescens pilosus fere a basi in inflorescentiam pyramidatam paniculatam ad 15 cm. altam ramosus. Bracteae infimae semiamplexicaules vix laminatae, supremae lineares. Rami paniculae 6–8 graciles stricti adscendentes ad 5 cm. longi 3–4-flori; pedicelli filiformes rigidi erecti rubro-glanduloso-pilosi. Sepala ovata obtusa rubro-glandulosa 2 mm. longa trinervia nervis sub apice in hydathodum confluentibus, in anthesi reflexa. Petala unguiculata majora 1 vel 2 anguste lanceolata acuta ad 8 mm. longa 1 mm. lata penninervia albida vel macula basali lutea, minora 4 vel 3 ovata acuta 3 mm. longa 1·5 mm. lata maculis basalibus duabus luteis caeteroquin rubro-maculata penninervia. Staminum filamenta alba anguste clavata petalis minoribus duplo longiora, antheris roseis. Discus unilateralis inter petala minora et ovarium quod aequat tuberculatus aurantiacus. Ovarium pulvinatum; styli albidi a basi divergentes.

Species *S. cortusaefoliae*, Sieb. et Zucc. affinis statura minore, foliis adultis superne glabris non albido-nervosis distincta.

West Hupeh. Wilson. No. 461. June 1900.

THE INFLUENCE OF DIFFERENT MEDIA ON THE HISTOLOGY OF ROOTS. By SOPHIE J. WILKIE, B.Sc., Carnegie Scholar, St. Andrews University. (Plate I.)

(Read 14th October 1915.)

The following is a short note on the differences found in the anatomical structure of the roots of *Monstera deliciosa*, Liebm., when grown

(1) In air.
(2) In soil.
(3) In water.
(4) In wet gravel.
(5) In damp soil.

Constantin in a paper published in the Annales des Sciences Naturelles, sér. 7, tome i, 1885, pp. 135 to 178, gives an account of the differences found in the structure of roots when grown in air, soil, and water.

His general conclusions are :—

(1) That aerial roots are characterised by the strong development of the central cylinder and of the vascular and stereom tissues.

(2) That soil roots show a reduction in the amount of pith; sclerenchyma and lignified vessels are of minor importance, and there is a very broad outer cortex.

(3) Water roots are very similar to soil roots, but they differ in respect that they possess large intercellular spaces, and the vascular system is weaker.

In Constantin's opinion the most important point which his research brings to light is that lignin is developed with difficulty in soil and water roots.

Haberlandt (Wollny's Forsch.—Influence of moisture on the development of stereom, 1, pp. v, sqq.) showed that the development of the mechanical tissue is affected by the humidity of the soil. He found that an increase in the water content of the soil had a favourable effect on the development of the mechanical tissue of *Cannabis sativa*, Linn.

The material used for the following work on *Monstera deliciosa* was fixed in corrosive sublimate, and after wash-

ing well with water was taken through the graded alcohols to 90 per cent. alcohol. Sectioning was done by hand, and before proceeding to stain the sections were placed in iodine for a few minutes in order to get rid of any mercuric chloride. The stains used were iodine green and picric fuchsine, or Bismarck brown and Ehrlich's acid hæmatoxylin.

The points which were studied in connection with this piece of research were the absorptive areas and the mechanical and fundamental tissues; the material did not permit of a comparison of the vascular systems.

Structure of the Adult Aerial Root of Monstera deliciosa.

The central conducting portion of the aerial root consists of alternating strands of xylem and phloem, with the vessels increasing in size towards the centre. These vascular strands are divided into groups of one or more large vessels surrounded by smaller ones. The elements of the protoxylem are spiral, and of the metaxylem the vessels are scalariform, while the contiguous vessels are provided with transverse pitted plates.

The ground tissue of this root is completely sclerosed, the cell walls being very thick and the markings well defined. An irregular row of from one to three cells deep of thick-walled pitted cells divides the outer cortex from the inner cortex. On the outside border of this layer there are cells rich in rhombohedral crystals of calcium oxalate.

The cortex is composed of large polyhehric cells, stellate crystals of calcium oxalate are scattered throughout, but they are more numerous towards the periphery. The fibrous hairs so common in the Aroideae are found in quantity in the intercellular spaces. Surrounding the cortex is the thin-walled cambial tissue from which the suberised layers are developed, and lastly there is the piliferous layer which persists in the adult roots (*cf.* Van Tieghem's description of the root of *Monstera repens* in his paper on "Structure des Aroidées," Annales des Sciences Naturelles, sér. 5, tome vi, p. 147).

The adult roots of *Monstera deliciosa* grown in the other four media, soil, water, gravel, and damp soil, show the same general structure as the aerial root, but they differ in the

thickness of the walls of the sclerosed ground tissue and of the cells of the "multiple endodermis." The extent of thickening in both cases is progressively less, as in the order stated—

(1) Aerial.
(2) Damp soil.
(3) Gravel.
(4) Water } same.
(5) Soil

In the cortex of the water-culture roots lacunae are found. Freidenfelt in "Der anatomische Bau der Wurzel," Bibliotheca Bot., 1904, p. 75, shows that an increase in the water content of the soil decreases the number of hairs found on the root. The piliferous layers of the roots cultivated in the different media vary. Aerial, soil, and gravel roots have practically the same quantity of hairs, but the respective average lengths are 1·25 mm., 1·15 mm., 1·08 mm. The hairs of the water roots are more numerous, but they are short, the average length being ·47 mm. The piliferous layer of the damp-soil roots is feebly developed, and the average length of the hair is ·5 mm.

SUMMARY.

1. The development of the absorptive layer varies inversely with the humidity of the medium.

2. The development of the mechanical tissue varies directly with the humidity of the medium.

3. There is no variation, as one would expect, in the size of the intercellular spaces of the fundamental tissue, excepting the presence of lacunae in the cortex of the water roots.

EXPLANATION OF PLATE.

Monstera deliciosa.

FIG. 1. *T S root grown in water.*

(*a*) Multiple endodermis.
(*b*) Sclerosed ground tissue.
(*c*) Fibrous hair.
(*d*) Lacuna.

FIG. 2. *T. S. aerial root.*

Letters as in fig. 1.

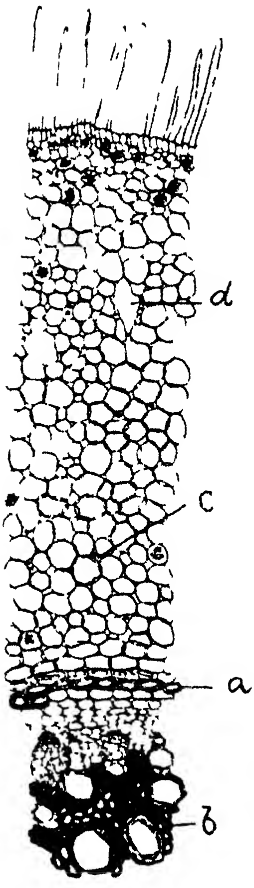


Fig. 1

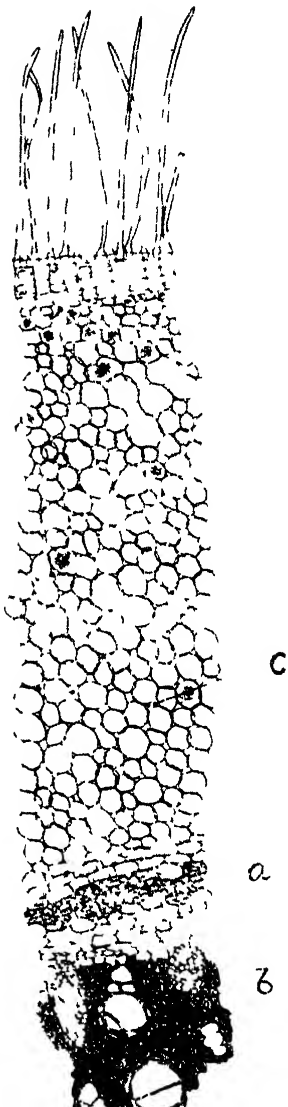


Fig. 2.

Miss S. J. Wilkie.

Rhododendron trichocladum, Franch., and its Allies.

By Professor Bayley Balfour, F.R.S.

(Read 13th April 1916.)

This is a small group of Western Chinese species characterised by deciduous leaves and small yellow precocious flowers. We know more or less of four species in the group—*Rh. trichocladum*, Franch., from the Tali Range: *Rh. mekongense*, Franch., from Mt. Sila on the Mekong-Salween divide; *Rh. melinanthum*, Balf. f. et Ward, from East Burma close to the Yunnan boundary, near Atuntsu: and *Rh. xanthinum*, Balf. f. et W. W. Sm., from the Shweli-Salween divide. Of these *Rh. trichocladum*, Franch., has flowered in cultivation from seeds collected by Forrest. From herbarium specimens I judge that *Rh. xanthinum* Balf. f. et W. W. Sm., is the most desirable of the species from the horticultural standpoint.

In all the species the young parts are coated with an indumentum of long, somewhat tawny, hairs intermixed with the peltate scales of a lepidote surface. As elsewhere amongst Rhododendrons, the stalks of the scales are sunk in shallow pits of the laminar surface, but the disk of the scale is well outside the pit, and this allows its marginal series of cells to expand as a peripheral fringe. Here the component cells of the fringe remain in contact one with the other throughout their extent and do not branch, so that the fringe is entire. The hairs, which may be stiff and erect (*Rh. trichocladum*, Franch.) or lanate and interwoven (*Rh. xanthinum*, Balf. f. et W. W. Sm.), may persist on the twigs to the second year or longer, or may fall off early, and similarly the leaf may, except on the petiole and the base of the midrib above and below, lose entirely the hairs, but all stages of the shedding are to be met with. The under surface of the leaf in all the species is less markedly coated with wax than is the case in the small yellow-flowered species of the Brachyanthum group; indeed in *Rh. trichocladum*, Franch., one can hardly speak of the surface as having a "bloom." Correlated with this, the epidermal papillae, which carry the wax, are short and conical.

The general similarity in flower structure that marks the

group is the presence of few-flowered (3–5) umbels of small flowers with sulphur-yellow corollas. The corolla is shortly campanulate, always lepidote outside, and pubescent on the back of the tube inside. The lobes are large and apparently patent in full flower. The ten stamens, always shorter than the corolla, have large ovoid anthers, and the filaments of the posterior ones are white villous about the middle just at the top of the ovary, and thus form a pompon at the mouth of the corolla tube. The other stamens are shortly pubescent for a short distance from the base upwards. The ovary is always lepidote. The style, glabrous and decurved, expands into a lobulate stigma.

KEY TO THE SPECIES

Hispid with long stiff hairs:
- Calyx lobes 5 mm. long, long ciliate. Corolla 2 cm long lepidote outside. Style shorter than or equalling stamens . . . . *trichocladum*
- Calyx lobes 4 mm. long, long ciliate. Corolla 1 cm long lepidote outside. Style described as shorter than ovary? . . . . *mekongense*

Lanate:
- Calyx lobes 2 mm. long scarcely ciliate. Corolla 2 cm long lepidote outside. Style longer than stamens . *melinanthum*
- Calyx lobes 2 mm. long barbate. Corolla 2 cm. long lepidote and lanate outside. Style shorter than stamens . . . . *xanthinum*

Rhododendron trichocladum, Franchet in Bull. Soc. Bot. Fr., xxxiii (1886), 234.[1]

Undershrub, branchlets of the year hairy with lutescent rigid setae. Leaves firmly chartaceous obovate, dark green above with adpressed strigose hairs and with scattered lutescent squamellae, pale beneath and more densely lepidote, also hirtellous on the midrib and margin as well as on the petiole with rigid setae. Flowers 3–4 fasciculate at the apex of the branchlets, pedicels elongate and patently

[1] *Rh. trichocladum.*—Fruticulus, ramis hornotinis setis rigidis lutescentibus hirtis. Folia firmiter chartacea, obovata, supra atrovirentia, pilis strigosis adpressis, squamulisque lutescentibus conspersa, subtus pallida magis dense lepidota et praeterea ad nervum medium, simul ac ad marginem et petiolum setis rigidis hirtella. Flores 3–4, ad apicem ramulorum fasciculati, sulphurei, pedunculis elongatis simul et calycibus patentim villosis; calyx membranaceus ex viridi lutescens, lobis ovatis longe fimbriato-ciliatis; corolla glabra, tubo brevissimo, rotata fere 2 cent. diam.; stamina 10, filamentis brevibus ad medium hirtellis; ovarium dense lepidotum.

villous like the calyx. Calyx membranaceous, greenish lutescent with ovate long-fimbriate ciliate lobes. Corolla rotate sulphur-yellow glabrous, almost 2 cm. diam., tube extremely short. Stamens 10 with short filaments hirtellous at the middle. Ovary densely lepidote.

Yunnan:—On Mount Tsang-Chan. Delavay.

So much Franchet, l.c.

I add the following comments:—

The branchlets of the year have, in addition to the setae, scattered lutescent scales like the leaves. In their second year the branchlets have lost all or most of the hairs and are brownish in tint. The older branches are ash-grey. The foliage buds are ovoid, the bud scales brown leathery, all the outer ovate to ovate rounded—the outermost slightly pointed, those within more rounded and mucronulate, when expanded lepidote on back, and all are more or less shortly ciliate. The innermost become oblong or obovate and pass into foliage leaves. The young leaves often have an abundance of rigid setae on the upper surface. These always disappear early, and I find that the adpressed strigose hairs on the upper surface are not apparent elsewhere than on and about the midrib. The paleness of the under leaf-surface is due to the granular wax on the surface of the epidermal papillae, which here are very short and conical, but the layer never suffices to give the impression of waxy bloom such as one sees in *Rh. melinanthum*, Balf. f. et Ward, or in *Rh. sulfureum*, Franch The peltate scales have an entire fringe, and the umbo is slightly convex and rubiginose. The pedicels are also lepidote. The flower bud scales are quite like those of the vegetative buds. The calyx lobes are often oblong, about 5 mm. long by 2 mm. broad. The sulphur-yellow corolla is about 2 cm. long with the lobe about 1 cm. wide or more, and the tube strongly pubescent inside on the posterior side. Of the ten stamens four posterior are villous about middle just above the ovary, the others are slightly pubescent from near base a short way upwards. The scales of the ovary have a fringe and are like those of the leaf. The short glabrous style is decurved. The ovary is ovoid, about 4 mm. long; the style is about 7 mm. long, expanding into the lobed stigma. The capsule is small ovoid oblong,

about 8 mm. long and 3 mm. broad, with vestiges of the squamules.

The dried specimens I have examined are:—

Yunnan:—Les coteaux de Tchang-chan. Alt. 3000 m. Delavay. Herb. Paris.

Yunnan:—Mekong-Yangtze divide. Moist open situations in pine forests on the ascent of the Wei Hsi pass. Lat. 27° 15′ N. Alt. 10,000 ft. G. Forrest. No. 698. Sept. 1904. Herb. Edin

Yunnan:—Eastern flank of the Tali Range. Lat. 25° 40′ N. Alt. 9000–10,000 ft. Shrub of 2–4 ft. Foliage deciduous, flowers pale yellow. Open rocky situations in side valleys. G. Forrest. No. 4145. May–June 1906. Herb. Edin.

Yunnan:—Eastern flank of the Tali Range. Lat. 25 40′ N. Alt. 10,000–11,000 ft. Shrub of 2–4 ft. Flowers bright yellow. In rhododendron and cane scrub. G. Forrest. No. 6755. June 1910. Herb. Edin.

Yunnan:—Tali Range. Lat. 25° 40′ N. Alt. 10,000–11,000 ft. Shrub of 2–4 feet. Flowers precocious, bright yellow. Open pasture on the margins of rhododendron thickets. G. Forrest. No. 11,630. July 1913. Herb. Edin.

Yunnan:—Tali Range. Lat. 25 40′ N. Alt. 10,000–11,000 ft. G. Forrest. No. 12,423. May 1914. Herb. Edin.

I have also seen twigs of plants grown by Mr. Williams at Werrington, and we have in the Royal Botanic Garden several plants—some of them flowered in 1915—which were raised from seed collected by Mr. Forrest and presented to the Garden by Bees, Ltd. The plant is hardy and an interesting addition to our small yellow-flowered garden species. I notice that some of these living plants have not shed their leaves after the first season.

Mr. Forrest tells me the plant is abundant on the Tali Range.

Rhododendron mekongense, Franch. in Journ. de Bot. xii (1898), 263.[1]

[1] *Rhododendron mekongense.* (*Azalea* sensu Maxim.)—Rami virgati ramosi, in vicinitate inflorescentiae simul ac ramuli novelli pilis longis hispidi; folia post flores evoluta (adulta non vidi), juvenilia oblongo-obovata, 15–25 cent. longa, petiolo et ad marginem hirsuta, apice rotundata cum mucronulo, supra intense viridia, glabra, subtus glauca,

Branches virgately branched, hispid with long hairs in the vicinity of the inflorescence and also on the young branchlets. Leaves (which are not known in the mature state) expanding after the flowers; young leaves oblong obovate, 15–25 mm. long, hirsute at the margin and on the petiole; apex rounded and mucronulate, deep green glabrous above, glaucous beneath and lepidote. Floral buds separated from the foliar buds small (4–5 mm.) glabrous. Flowers terminal, 3–5, loosely fasciculate; pedicels 10–12 mm. long lepidote. Calyx 4 mm long with lanceolate obtuse lepidote lobes ciliate at the margin with fuscous hairs. Corolla yellow, 1 cm. long, 12 mm. wide, shortly and widely tubular with obovate cup-shaped lobes; stamens 8–10 included, filaments lanate below. Ovary closely lepidote, longer than the glabrous style.

Mt. Sila in the Mekong Valley, between the Mekong and the Salween. Soulié.

The corolla is like that of *Rh. brachyanthum*, Franch., but the calyx has a different form, and the presence of hairs upon the branches and upon the leaves and the precocity of the flowers in *Rh. mekongense*, Franch., distinguish well the two species.

So much Franchet l.c.

I add the following comments:—

This species, imperfectly known, is a difficult one. Through the kindness of M. Lecomte I have seen a specimen of Soulié's collecting under No. 1004 from the locality of the type. I have made a careful analysis of this specimen and find no character by which I can separate it from *Rh. trichocladum*, Franch. Without doubt they are the same species. In a note to his description of *Rh. mekongense*, Franchet compares his species with *Rh. brachyanthum*, Franch., and from that species Soulié's plant is easily diagnosed on the lines marked out by Franchet. But it is remarkable that Franchet says

lepidota; gemmae florales at foliaceis sejunctae, parvae (4–5 mm.), glabrae; flores terminales laxe fasciculatae, circiter 3–5, luteae; pedunculi 10–12 mm. lepidoti; calyx 4 mm., lobis lanceolatis, obtusis, lepidotis, margine pilis fuscis ciliatis; corolla 1 cent. longa, 12 mm. lata, breviter et late tubulosa, lobis obovatis, poculiformibus; stamina 8–10, inclusa, filamentis inferne lanatis; ovarium crebre lepidotum, stylo glabro longius.

nothing about *Rh. trichocladum*, Franch., as an ally of *Rh. mekongense*, Franch.

In 1906 I endeavoured to match Forrest's specimen No. 698—this is the same as Monbeig No 7 in Kew Herbarium: so like are they they might have been plucked from the same bush—with specimens named by Franchet in the Paris Herbarium, and found the match in a specimen named *Rh. mekongense*, Franch., without entering into a critical investigation of distinction from *Rh. trichocladum*, Franch. Now having good material of *Rh. trichocladum*, Franch., both dried and living specimens of Forrest's and dried ones of Monbeig's plants, I am satisfied that they do not differ from *Rh. trichocladum*, Franch. This adds, I think, to the evidence pointing towards the identity of *Rh. mekongense*, Franch., with *Rh. trichocladum*, Franch.

Turning now to the words of the technical description of the two species *Rh. trichocladum*, Franch., and *Rh. mekongense*, Franch. (the adult leaves of *Rh. mekongense*, Franch., are unknown), the only characters available for distinction are:—

a. The corolla cup-shaped, 1 cm. long in *Rh. mekongense*, Franch.; rotate and 2 cm. long in *Rh. trichocladum*, Franch.

b. The ovary longer than the style in *Rh. mekongense*, Franch.; shorter in *Rh. trichocladum*, Franch.

Short corollas occur, however, in *Rh. trichocladum*, Franch., and its rotateness is often hardly marked—easily merging into cup-shaped.

As to the relative length of the ovary and style Franchet writes, "ovarium crebre lepidotum, stylo glabro longius." This would be an unusual character in this series of Rhododendrons—though it is met with in the Lapponicum group and in the Anthopogon group—and I suspect a misprint: perhaps we should read, "stylo glabro longissimo." The character named by Franchet does not appear in Soulié's specimen No. 1004.

What I have said about its relationship with *Rh. trichocladum*, Franch., does not end my difficulty over *Rh. mekongense*, Franch. Kingdon Ward collected in the Kagwr-pw glacier valley, which is near Atuntsu, a pretty

yellow-flowered species which now bears the name *Rh. melinanthum*, Balf. f. et Ward. The locality is not far from Mt. Sila, where Soulié obtained *Rh. mekongense*, Franch., and I have tried to see in Ward's plant Franchet's species. The characters of *Rh. melinanthum*, Balf. f. et Ward, are quite definite, separating it readily from *Rh. trichocladum*, Franch., and its short calyx, longer pedicels and long projecting style do not fit in with Franchet's description of *Rh. mekongense*, Franch.

Until more material is available we must leave the question where it stands.

Rhododendron melinanthum. Balf. f. et Ward.[1] Sp. nov.

A bushy shrub, 6–8 ft. high, with slender scarcely twiggy branches and leaves deciduous after one season. Branchlets of the year are about 1 mm. in diam., clad with long setae

[1] *Rhododendron melinanthum*, Balf. f. et Ward.—Frutex circ. 2–2·5 m. altus tenuiramosus vix virgatus. Ramuli hornotini circ. 1 mm. diam. pilis setiformibus plus minusve praediti et squamulis peltatis rufis perpaucis intermixtis obsiti annotini glabri albidi. Alabastra ovoidea parvula cataphyllis externis ovatis spadiceis circ. 1 mm. longis glabris intermediis spadiceis oblongis circ. 7 mm. longis acutis vel obtusis vel subtruncatulis extus lepidotis internis submembranaceis vel subfoliaceis lepidotis. Folia parva brevissime petiolata ad 4·5 cm. longa; lamina anguste obovata vel oblanceolata circ. 4 cm. longa 1·5 cm. lata chartacea apice subrotundo-obtusa minute mucronulata margine plana basi cuneata supra laete viridis costa media tenui minutissime puberula venulis primariis delicatis utrinsecus ad 6 ultimisque (siccitate) leviter elevatis ubique minutissime granulosa subtus glauca papillis epidermicis ceriferis obtecta lepidota squamulis peltatis inaequalibus integromarginatis conspersis epilosa vel margine et pagina inferiore pilis setiformibus sparsissimis praedita (juventute hirsuta). Inflorescentia terminalis umbellata plerumque 4-flora. Flores plus minusve praecoces. Bracteae mox deciduae (non visae). Pedicelli circ. 1·5 cm. longi tenues stricti sparse lepidoti nunc etiam pilis longis hirsuti. Calyx parvulus lobis 5 ovatis vel deltoideis ad 2 mm. longis glaberrimus vel lepidotis rarissime pilis paucis fimbriatis. Corolla lutea extus sparsim lepidota epilosa breviter campanulata vel subpoculiformis circ. 2 cm. longa tubo 1 cm. longo intus puberulo limbi ampliati lobis 5 rotundatis circ. 1 cm. latis. Stamina 10 inaequalia corolla breviora filamentis paucis posterioribus fere ad apicem albo-villosis caeteris basin versus puberulis. Ovarium anguste ovoideum circ. 5 mm. longum dense lepidotum; stylus ultra corollam exsertus ad 2 cm. longus glaberrimus; stigma lobulatum.

Species burmanica ex affinitate *Rh. trichocladi*, Franch. et *Rh. mekongensis*, Franch. ab hoc pilis lanatis non hispidis, pedicellis longioribus, ovario angustiore, stylo corollam superante, ab illo foliis longioribus angustioribus pagina superiore haud strigoso-puberula inferiore glauciore papillis ceriferis longioribus, pedicellis duplo longioribus, calycis lobis parvis haud hirsutis, corolla haud rotata, stylo duplo longiore longe exserto.

and a few peltate reddish scales; the whitish one-year-old branches have neither hairs nor scales. Leaf buds are small and ovoid, covered by chestnut-brown oblong pointed or blunt scale-leaves, which are more or less lepidote on the outside. Leaves small, very shortly stalked, at most 4·5 cm. long; blade narrowly obovate or oblanceolate, at most 4 cm. long and 1·5 cm. broad, thin, papery, blunt somewhat rounded at the apex, minutely mucronulate with a flat margin and cuneate base, bright green on the upper surface without hairs except for a few minute ones over the midrib (which is slender and slightly prominent, as are the primary veins, which are about 6 on each side, and also the ultimate branches of the venation at least in the dried state), on the under side showing a glaucous wax bloom not very white and lepidote with discontiguous peltate unequal superficial scales which have an entire fringe, the whole leaf devoid of setae except perhaps for a few on the margin and under surface, the remains of a dense covering in youth. Inflorescence a terminal umbel of about 4 flowers, which expand before the leaves. Bracts falling off early. Pedicels about 1·5 cm. long, stiff, slender, and sparingly lepidote, occasionally setulose also. Calyx small with 5 ovate or deltoid lobes about 2 mm. long, without hairs or scales or rarely with a few. Corolla yellow, sparingly lepidote outside but without hairs there, about 2 cm. long, shortly campanulate or somewhat cup-shaped, expanding into a spreading limb with a tube 1 cm. long, puberulous inside and 5 rounded lobes each about 1 cm. broad. Stamens 10 unequal, shorter than the corolla with large ovoid anthers and the posterior filaments densely girt with white hairs about the middle and just above the ovary, the other stamens being shortly puberulous near the base only. Ovary ovoid, about 5 mm. long, densely lepidote; style longer than corolla, about 2 cm long, quite glabrous and slightly declinate, stigma lobulate.

E. Upper Burma:—Ka-gwr-pw glacier valley. Abies forest. Alt. 12,000–14,000 ft. Kingdon Ward. No. 406. June 1913. Flowers large yellow. Bushy shrub of 6–8 ft.

A bright-flowered species which should be worthy of cultivation. It is easily distinguished from *Rh. tricho-cladum*, Franch., by its larger adult leaves without hairs

on the upper surface, by the more glaucous tint of the under surface of the leaf where the epidermal papillae are longer, by the flower pedicels nearly twice as long, by its small calyx, which is not hirsute, and by the much longer exserted style. Of its relations to *Rh. mekongense*, Franch., I have written under that species.

Rhododendron xanthinum, Balf. f. et W. W. Sm.[1] Sp. nov.

Small shrub about 1·5 meters high, with short twisted branches and leaves deciduous after one season. Branchlets of the year clad with twisted long interlocking hairs and also sparingly lepidote: one-year-old branches grey and without hairs or scales. Leaf buds small oblong ovoid, the bud scales all shortly ciliate at the apex and the inner lepidote on the back. Leaves at most 3 cm. long, appearing after the flowers; blade thin papery, at most about 2·7 cm. long and 7 mm. wide, oblong or narrowly obovate obtuse or somewhat rounded or even acute at the apex with a flat

[1] *Rhododendron xanthinum*, Balf. f. et W. W. Sm – Fruticulus ad 15 dm. altus tortuose breviterque ramosus. Ramuli hornotini pilis lanatis dense vestiti sparsimque lepidoti annotini glabri grisei. Alabastra parva oblongo-ovoidea cataphyllis brunneis exterioribus subrotundatis apice breviter ciliatis interioribus oblongis obtusis circ. 6 mm. longis extus plus minusve lepidotis apice ciliatis. Folia post flores evoluta ad 3 cm. longa; lamina tenuis chartacea circ. 2·7 cm. longa 7 mm. lata oblonga vel anguste obovata apice obtusa nunc subrotundata nunc subacuta margine plana basi cuneata supra sordide viridis subtus pallidior utrinque juventute pilis lanatis fuscis squamulisque superficialibus peltatis integro-fimbriatis lutescentibus discontiguis subtus densius obtecta maturitate supra pilis squamulisque paucis sparsa nunc omnino glabra infra semper lepidota sed costa media basi excepta fere epilosa venarum reticulo purpurascente; petiolus ad 4 mm. longus dense lanatus et plus minusve lepidotus. Flores in umbellam terminalem circ. 3-floram dispositi praecoces; bracteae non visae; pedicelli circ. 1·3 cm. longi lanati et lepidoti superne in calycem lanato-barbatum expansi. Calyx pilis lanatis occultus lobis 5 circ. 2 mm. longis. Corolla lutea circ 2 cm. longa anguste campanulata extus pilis lanatis plus minusve obtecta et lepidota, tubo circ. 1 cm. longo intus pubescente, limbi ampliati lobis 5 rotundatis circ. 1 cm. diam. integris patentibus. Stamina 10 corolla breviora filamentis posterioribus medium versus albo-villosis os corollinum oppletentibus anterioribus basin versus plus minusve pubescentibus. Ovarium ovoideum circ. 3 mm. longum lepidotum et pilis lanatis ad apicem praecipue plus minusve obtectum; stylus circ. 8 mm. longus stamina subaequans declinatus glaber; stigma lobulatum.

Species yunnanensis *Rh. tricholado*, Franch. persimilis ramulis brevibus subintricatis haud virgatis, foliis angustioribus, calyce lanato barbato, corolla extus pilis lanatis obtecta differt.

margin and cuneate base, dull green above, paler beneath but without marked glaucous bloom, when young clad on both sides, but more densely below, with long intricate pale brownish hairs and also lepidote with pale shining superficial discontiguous scales; older leaves have lost more or less the hairs and scales from the upper side and are lepidote below with some hairs on the base of the midrib and covering the petiole—the midrib and primary veins and the veinlets tend to become a dark red colour and are not prominent; petiole, at most 4 mm. long, is densely coated with long intricate hairs and more or less lepidote. The flowers are grouped in terminal umbels of about 3 flowers and are precocious. Bracts are soon deciduous Pedicels are at most 1·3 cm. long with hairs and scales, and expand into the calyx, which is so densely bearded its surface is hidden. Calyx lobes 5. Corolla yellow, about 2 cm. long, narrowly campanulate lepidote outside and pilose, the tube is about 1 cm. long and is pubescent inside, the ample limb has 5 rounded spreading entire lobes about 1 cm. in diameter. The stamens are 10 shorter than the corolla with large ovoid anthers, and the filaments of the posterior stamens whitely villous about the middle, filling up the mouth of the corolla above the ovary, the others are puberulous at the base. The ovoid ovary, about 3 mm. long, is lepidote and also bears long twisted hairs, especially at the top; style more or less declinate is about 8 mm. long and quite glabrous; stigma lobulate.

Yunnan:—Shweli-Salween divide. Lat. 25° 30′ N. Alt. 10,000 ft. Shrub of 2–4 ft. Flowers precocious, canary-yellow. Open stony slopes on the margins of thickets. G. Forrest. No. 12066. June 1913.

This species is without doubt the representative on the Shweli-Salween divide of *Rh trichocladum*, Franch., which is spread over the Tali Range. The Shweli-Salween plant differs from *Rh. trichocladum*, Franch., in habit. It forms a somewhat intricately branched small shrub wanting the stouter virgate twigs of *Rh. trichocladum*, Franch. Then the hair indumentum here is always lanate in type, not hispid. Further, the calyx has a dense beard of hairs coating it, and the corolla has hairs on the outside in addition to scales.

New Garden Dracocephalums from China. By W. W. Smith, M.A., and George Forrest.

(Read 13th April 1916.)

During the last two years further botanical material has been obtained in the rich alpine regions of North-West Yunnan, and amongst this material (as yet but inadequately examined) are certain interesting new Dracocephalums with pinnatifid leaves, some of which are already in cultivation and will prove of undoubted horticultural value. Previous to the discovery of these, only one pinnatifid-leaved member of this genus was recognised as being Chinese—*D. tanguticum*, Maxim.,—and in the recently published Key to the Labiatae of China (S. T. Dunn, B.A., F.L.S., in Notes R.B.G. Edin., vi, 127) that species is separated from its Chinese allies by its pinnatifid leaves. Moreover, all the Kansu, Szechuen, and Yunnan sheets with such leaves are referred to that species We have previously acquiesced in this arrangement, which we saw no good reason to dispute, supported too as it was by both Professor Diels and Mr. Dunn, authorities on the Flora of China of the highest standing. But further experience in the field and acquaintance with the plants under cultivation have forced us to the conclusion that *D. tanguticum* is an aggregation of very distinct plants which in gardens would be looked upon as meriting definite specific names. As regards the Yunnan species of the group, observation in the field with the discovery of new allies strongly supports this conclusion. Garden experience of the newer plants points in the same direction.

It was the discovery of *D. Isabellae* (described by one of us in Notes R.B.G. Edin., viii, 211) which first suggested the possibility of a series of closely allied species of the *D. tanguticum* type. This very beautiful species was found on the Chungtien plateau, and is now in cultivation. It possesses leaves almost identical with those of *D. tanguticum*, but its magnificent flowers have distinct characters of their own. Then followed a small-flowered species which is described below as *D. propinquum*; in habit and

margin and cuneate base, dull green above, paler beneath but without marked glaucous bloom, when young clad on both sides, but more densely below, with long intricate pale brownish hairs and also lepidote with pale shining superficial discontiguous scales; older leaves have lost more or less the hairs and scales from the upper side and are lepidote below with some hairs on the base of the midrib and covering the petiole—the midrib and primary veins and the veinlets tend to become a dark red colour and are not prominent; petiole, at most 4 mm. long, is densely coated with long intricate hairs and more or less lepidote. The flowers are grouped in terminal umbels of about 3 flowers and are precocious. Bracts are soon deciduous. Pedicels are at most 1·3 cm. long with hairs and scales, and expand into the calyx, which is so densely bearded its surface is hidden. Calyx lobes 5. Corolla yellow, about 2 cm. long, narrowly campanulate lepidote outside and pilose, the tube is about 1 cm. long and is pubescent inside, the ample limb has 5 rounded spreading entire lobes about 1 cm. in diameter. The stamens are 10 shorter than the corolla with large ovoid anthers, and the filaments of the posterior stamens whitely villous about the middle, filling up the mouth of the corolla above the ovary, the others are puberulous at the base. The ovoid ovary, about 3 mm. long, is lepidote and also bears long twisted hairs, especially at the top; style more or less declinate is about 8 mm. long and quite glabrous; stigma lobulate.

Yunnan:—Shweli-Salween divide. Lat. 25° 30′ N. Alt. 10,000 ft. Shrub of 2–4 ft. Flowers precocious, canary-yellow. Open stony slopes on the margins of thickets. G. Forrest. No. 12,066. June 1913.

This species is without doubt the representative on the Shweli-Salween divide of *Rh. trichocladum*, Franch., which is spread over the Tali Range. The Shweli-Salween plant differs from *Rh. trichocladum*, Franch., in habit. It forms a somewhat intricately branched small shrub wanting the stouter virgate twigs of *Rh. trichocladum*, Franch. Then the hair indumentum here is always lanate in type, not hispid. Further, the calyx has a dense beard of hairs coating it, and the corolla has hairs on the outside in addition to scales.

New Garden Dracocephalums from China. By W. W. Smith, M.A., and George Forrest.

(Read 13th April 1916.)

During the last two years further botanical material has been obtained in the rich alpine regions of North-West Yunnan, and amongst this material (as yet but inadequately examined) are certain interesting new Dracocephalums with pinnatifid leaves, some of which are already in cultivation and will prove of undoubted horticultural value. Previous to the discovery of these, only one pinnatifid-leaved member of this genus was recognised as being Chinese—*D. tanguticum*, Maxim.,—and in the recently published Key to the Labiatae of China (S. T. Dunn, B.A., F.L.S., in Notes R.B.G. Edin., vi, 127) that species is separated from its Chinese allies by its pinnatifid leaves. Moreover, all the Kansu, Szechuen, and Yunnan sheets with such leaves are referred to that species. We have previously acquiesced in this arrangement, which we saw no good reason to dispute, supported too as it was by both Professor Diels and Mr. Dunn, authorities on the Flora of China of the highest standing. But further experience in the field and acquaintance with the plants under cultivation have forced us to the conclusion that *D. tanguticum* is an aggregation of very distinct plants which in gardens would be looked upon as meriting definite specific names. As regards the Yunnan species of the group, observation in the field with the discovery of new allies strongly supports this conclusion. Garden experience of the newer plants points in the same direction.

It was the discovery of *D. Isabellae* (described by one of us in Notes R.B.G. Edin., viii, 211) which first suggested the possibility of a series of closely allied species of the *D. tanguticum* type. This very beautiful species was found on the Chungtien plateau, and is now in cultivation. It possesses leaves almost identical with those of *D. tanguticum*, but its magnificent flowers have distinct characters of their own. Then followed a small-flowered species which is described below as *D. propinquum*; in habit and

inflorescence it is further removed from the Kansu plant of Przewalski (type of *D. tanguticum*) than is the Yunnan plant cultivated in this country under *D. tanguticum*. It is in cultivation, and its behaviour there is all in favour of its specific distinctness; in the form of the leaves and in the structure of the flower its *tanguticum* affinity is undoubted, yet no observer at first sight would imagine them to be even closely related. This dissimilarity led us then to doubt the correctness of the view which associated the Yunnan "*D. tanguticum*" with the typical Kansu plant. The Yunnan plant has a distinct habit which is definite even in the first year's growth; its flowers are twice the size of those of the Kansu plant—worthy of note, although we would not attach much weight to that character if it stood alone The plant ought to have a distinguishing name, and as on its first appearance in the Royal Botanic Garden as a cultivated plant it bore for a while the name *D. Forrestii*, we propose to restore that appellation. A diagnosis is given below.

Another plant of the series is found on the Tali Range, more closely allied, in our opinion, than any of the others to the Kansu *D. tanguticum*. It is described below as *D. taliense*. Its area of distribution is in the Mekong basin, separated by a long and very high mountain range from the habitats of the other Yunnan species. Of these *D. Isabellae* and *D. propinquum* appear to be confined to the Chungtien plateau; *D. Forrestii*, at its optimum in the Lichiang Range, has outliers on the same plateau.

In our view then there are five species of this section with pinnatifid leaves known from China. Two have very large flowers, *D. Isabellae*, *D. Forrestii*, *D. tanguticum*, flowers of moderate size; *D. propinquum*, *D. taliense*, flowers decidedly smaller than those of the other species. In the Royal Botanic Garden during 1915 three of these were in flower—*D. Forrestii*, *D. Isabellae*, *D. propinquum*: the differences between them are manifest both in the early and in the late stages of development.

Dracocephalum Forrestii, W. W. Sm. Sp. nov.

Species valde affinis *D. tangutico*, Maxim. sed habitu,

inflorescentia vix interrupta potius densissima, verticillastris paucifloris, calycibus majoribus divergit.

Herba perennis 15–50 cm. alta caulibus gracilibus simplicibus vel ramosis dense foliatis plus minusve albo-villosulis internodis ±1 cm. longis. Folia 2–3-jugo-pinnatisecta vel 3-partita segmentis linearibus usque ad 2 cm. longis 1 mm. latis acutiusculis revolutis supra glabris nitentibus infra praesertim in costam albo-villosulis; folia in cultura aeque revoluta, nonnunquam subplana. Verticillastri saepius 2–4-flori numerosi 10–30, apice fere ad basim caulis orientes approximati inflorescentiam densam spiciformem bracteis magnis et calycibus purpureis ornatam formantes. Bracteae foliis subsimiles subaequales; bracteolae subulatae vel lineares calyce multo breviores; pedicelli 1–3 mm. longi. Calyx ±2 cm. longus anguste tubulosus dense albo-villosulus purpurascens: dentes ±7 mm. longi anguste lanceolati subspinescentes superiores paulo majores. Corolla ±3 cm. longa saturate purpureo-coerulea extus densius intus hic illic albo-villosula; tubus basi 2 mm. latus superne ventricoso-ampliatus 5–6 mm. latus. labium superum obovatum galeatum 5–6 mm. longum emarginatum: labium inferum patens ±1 cm longum lobo medio reniformi circ. 5 mm. lato lobis lateralibus subrotundatis multo minoribus. Stamina e tubo exserta filamentis longiuscule albo-villosis antheris glabris. Nuculae circ. 3 mm. longae trigono-oblongae compressiusculae minute papillosae glabrae nigrae.

Dracocephalum tanguticum, Diels vix Maxim. in Notes Roy. Bot. Gard. Edin., vii (1912), pp. 45, 187; Dunn, ibid., vi (1915), 168.

"Flowers deep blue. On dry grassy banks on the Chungtien plateau between descent of Niu Chang Pass and Hsia Chung Tien, Yunnan. Alt. 12,000–13,000 feet. Sept. 1904." G. Forrest, No. 605.

"Plant of 12–16 inches. Flowers deep blue. Whole plant aromatic. Open dry situations amongst scrub on the eastern flank of the Lichiang Range, N.W. Yunnan. Lat. 27 25′ N. Alt. 11,000 ft. Sept. 1906." G. Forrest, No. 3033.

"Plant of 6–10 inches. Flowers deep purplish-blue. Stony mountain meadows on the eastern flank of the

Lichiang Range. Lat. 27° 30′ N. Alt. 11,000–12,000 ft. Aug. 1910." G. Forrest, No. 6490.

Also Nos. 604, 11,297 from the Chungtien plateau, and No. 10,978 from the Lichiang Range.

Dracocephalum propinquum, W. W. Sm. Sp. nov.

Species affinis *D. tangutico*, Maxim. sed habitu ramoso verticillastris paucifloris floribus multo minoribus inter alia differt.

Herba perennis 30–45 cm. alta caulibus gracilibus basi ad apicem ramosis plus minusve albo-villosulis internodis 2–3 cm. longis. Folia variabilia, juvenilia saepe simplicia linearia circ. 1·5 cm. longa, seniora 2–3-jugo-pinnatisecta vel 3-partita segmentis linearibus 1 mm. latis acutiusculis revolutis supra glabris nitentibus infra praesertim in costam albo-villosulis; folia in cultura saepe plana 2 mm. lata. Verticillastri 1–2-flori, rarius 3–4-flori, in suprema parte caulis orientes satis remoti inflorescentiam spiciformem circ. 15 cm. longam formantes; rami aeque floribundi. Bracteae foliis subsimiles minores, simplices lineares vel tripartitae; bracteolae subulatae vel lineares calyce multo breviores; pedicelli ±1 mm. longi. Calyx 6–8 mm. longus anguste tubulosus albo-villosulus purpurascens; dentes 2–3 mm. longi lineari-lanceolati subspinescentes superiores paulo majores. Corolla 13–14 mm. longa violaceo-purpurea extus sparse albo-villosula; tubus basi 1 mm. latus superne ventricoso-ampliatus 3–4 mm. latus; labium superum obovatum galeatum 3–4 mm. longum emarginatum; labium inferum patens circ. 5 mm. longum lobo medio reniformi 5 mm. lato emarginato lobis lateralibus subrotundatis multo minoribus. Stamina e tubo exserta filamentis sparse villosis antheris glabris. Nuculae circ. 3 mm. longae trigono-oblongae compressiusculae minute papillosae glabrae nigrae.

"Plant of 12–18 inches. Flowers soft violet purple. Open stony pasture on the mountains in the N.E. of the Yangtze bend, Yunnan, West China. Lat. 27° 45′ N. Alt. 10,000 ft. Sept. 1913." G. Forrest, No. 11,195.

Also cultivated in Royal Botanic Garden, Edinburgh, from seed presented by J. C. Williams, Esq., Caerhays Castle, Cornwall.

Dracocephalum taliense, G. Forrest. Sp. nov.

Species valde affinis *D. tangutico*, Maxim. a quo habitu diverso, caulibus supra ramosis paucifloris, verticillastris 1–2-floris regione foliata haud discretis eacumque ± intermixtis inter alia recedit.

Herba perennis 45–60 cm. alta caulibus gracilibus infra simplicibus supra medium ramosis ramulis ascendentibus bene foliatis paucifloris. Folia 2–3-jugo-pinnatisecta segmentis linearibus usque ad 2·5 cm. longis 1 mm. latis acutis revolutis supra glabris subnitentibus infra ad costam prominentem albo-villosis. Verticillastri saepius 1–2-flori pauci vulgo 4–5 inflorescentiam laxam spiciformem (terminalem sed una cum regione foliata intermixtam) haud conspicuam formantes. Bracteae foliis simillimae: pedicelli fere nulli. Calyx ±1·2 cm. longus tubulosus mediocriter albo-villosulus viridis vel supra purpurascens; dentes 3–4 mm. longi triangulari-lanceolati subspinescentes. Corolla ±2 cm. longa saturate purpurea extus dense intus sparse albo-villosa; tubus supra ventricoso-ampliatus, labium superum circ. 3 mm. longum emarginatum, inferum circ. 5 mm. longum lobo medio reniformi. Stamina e tubo exserta filamentis albo-villosis. Nuculae maturae desunt.

"Plant of 1½–2 ft. Flowers deep soft purple, open dry situations amongst pine scrub and on ledges of cliffs on the western flank of the Tali Range, Yunnan. Lat 25° 40′ N. Alt. 10,000 ft. Aug. 1913." G. Forrest, No 11,524.

This species differs much less from the Kansu plant than the allied species do.

Note on Parasyringa, a New Genus of Oleaceae.

By W. W. Smith, M.A.

(Read 10th February 1916

In 1886 Franchet described under *Syringa sempervirens* a peculiar Yunnan plant and found it necessary to extend the scope of the genus *Syringa* for the accommodation of his new species. This he did by making a new section

Sarcocarpion, of which *Syringa sempervirens*, Franch., is the sole representative. Several characters of the new species accord ill with *Syringa*—the evergreen coriaceous foliage, the more or less fleshy mesocarp of the fruit, and the single wingless seed. The habit of the plant, moreover, does not suggest *Syringa*; so little is it reminiscent of that genus that anyone unacquainted with the plant would compare it with *Ligustrum* and its allies in his first attempt at identification. These difficulties have already been noted by Schneider in his Illustriertes Handbuch der Laubholzkunde, vol. ii, p. 771, from which I quote his apt note:— "Die *S. sempervirens*, Franchet, in Bull. Soc. Linn. Paris, i, 613, 1886, aus Yunnan, mit immergrunen B. und steinfruchtartiger Fr. mit etwas fleischigem Mesocarp und ungeflugelten Samen kenne ich nur aus einem Bl.-Exemplar, das viel mehr einem *Ligustrum* als einer *Syringa* gleicht. Franchet begrundete auf diese Art seine Sekt. *Sarcocarpion*. Meiner Meinung nach handelt es sich hier wohl um eine neue Gattung, doch konnte ich die Fr. noch nicht untersuchen."

The resemblance to the genus *Ligustrum* is well illustrated by the marked similarity in habit and leaves to *Ligustrum coriaceum*, Carr., an excellent figure of which is given in Bot. Mag, tab. 7519. The native country of this latter plant is not definitely known—it is possibly Japan; by many good authorities the plant is considered merely a growth form of *L. japonicum*, Thunb., which has arisen in Japanese gardens However that may be, the resemblance is so close that Mr. George Forrest (collector of the sheets quoted below) was at first sight inclined to believe that plants of the latter growing in the Royal Botanic Garden, Edinburgh, were the same as the Yunnan plant known to him. The fruits, however, of the two plants are quite distinct, that of *L. coriaceum* being a globose berry, the size of a small pea, that of the Yunnan plant oblong and dehiscing from the apex.

The plant is then somewhat awkwardly placed in *Syringa*, although nearly allied; its dehiscent fruit separates it readily from *Ligustrum* and other members of the *Oleineae*. I suggest as the generic name *Parasyringa*. Franchet's sectional name would be appropriate, but that name, with

a slightly different suffix, is, as Franchet himself points out, a synonym of *Kadsura*.

Parasyringa, W. W. Sm. Genus novum.

Calyx cupuliformis dentibus 4 brevissimis praeditus. Corolla tubulosa tubo calycem 2–3-plo superante, lobis 4 calyci subaequilongis induplicato-valvatis. Stamina 2 supra medium tubum affixa filamentis antheras aequantibus; antherae oblongae paululo exsertae medio dorso insertae. Ovarium 2-loculare; stylus ovario subduplo longior, stigmate breviter bifido; ovula in quoque loculo 2 ab apice loculi pendula. Drupa oblonga subteres mesocarpio tenui loculis inaequalibus altero casso altero abortu monospermo, apice dehiscens. Semen solitarium pendulum haud compressum exalatum; albumen carnosum; cotyledones planae radicula brevi supera Fruticulus glaber. Folia opposita integra coriacea persistentia. Flores in paniculas terminales densas dispositi. Species unica yunnanensis.

Parasyringa sempervirens, W. W. Sm. Comb. nov.
Syringa sempervirens, Franch., in Bull. Soc. Linn. Paris, i (1886), 613; Hemsl., in Journ. Linn Soc., xxvi (1889), 84, Diels, in Notes R. B. G. Edin., vii (1912), 116, 149, 257; Schneider, Handb. Laubholz, ii (1911), 771.

As the original description of the species is not in a readily accessible publication, I reproduce below Franchet's diagnosis:—

Sectio: *Sarcocarpion* (*Sarcocarpon* Bl. est *Kadsura* synon.).—Fructus drupaceus, mesocarpio rupto loculicide dehiscens; loculis valde inaequalibus: altero casso, ovulis abortientibus; altero rite evoluto, abortu monospermo. semen oblongum, vix compressum, exalatum, incurvum Frutex sempervirens, foliis coriaceis. Species hucusque cognita unica, infra descripta.

Syringa (*Sarcocarpion*) *sempervirens*, sp. nov.—Frutex bimetralis, ex toto glaber, ramosus, ramis, hornotinis angulatis, lenticellosis; folia breviter petiolata, limbo (1–1½ poll. longo) rigide coriaceo, late ovato vel suborbiculato, integerrimo, margine revoluto; cymae pauciflorae, secus ramos patentes paniculam terminalem pyramid-

atam efficientes; pedicelli inaequilongi (2–4 mill.), crassi; calyx cupuliformis obsolete crenatus; corolla alba tubulosa, tubo breviusculo (6–8 mill.) calyce subtriplo longiore, lobis demum reflexis, crassis, subobtusis; stamina circiter e medio tubi orta, antheris medio dorso insertis, oblongo-linearibus, corollam subaequantibus; stylus apice breviter bifidus; capsula drupacea, sub maturitate caerulescens, ovata, 12–15 mill. longa, semen unicum fovens.

Yun-nan, in montibus supra Tapintze, alt. 2500 m., legit *Delavay*.

The following sheets of the species are in the Herbarium of the Royal Botanic Garden, Edinburgh:—

"Dwarf shrub of 1–2 ft. Flowers creamy-yellow, fragrant. Dry shady situations on the margins of pine forests on the eastern flank of the Lichiang Range, Yunnan Lat 27° 30′ N. Alt. 12,000 ft. July 1910." G. Forrest, No. 6197.

"Evergreen shrub of 4–6 ft. Flowers immature, probably yellowish-white. In open shrub on the descent to the Yangtze from the eastern boundary of the Lichiang valley. Lat. 27° 15 N. Alt. 9000–10,000 ft. June 1913." G. Forrest, No. 10,124.

"Evergreen shrub of 6–9 ft. Foliage coriaceous. Flowers pale creamy-yellow, fragrant. Open scrub and in thickets in the mountains in the N.E. of the Yangtze bend, Yunnan. Lat. 27° 45′. Alt 8000–9000 ft. Aug. 1913" G. Forrest, No. 10,735.

"Shrub of 3–5 ft. In fruit. Open situations amongst scrub on the Yung-pe mountains, Yunnan Lat. 26° 45′ N. Alt. 9000 ft. Sept. 1913." G. Forrest, No 11,042.

I should add that young plants grown from seed (Forrest, No. 11,042), the gift of J. C. Williams, Esq., Caerhays Castle, Cornwall, are now in the Royal Botanic Garden. If, however, the rate of growth corresponds to that of *Ligustrum coriaceum*, Carr. (which in habit it so closely resembles), it will be some considerable time before it reaches the flowering stage.

RHODODENDRON LACTEUM, Franch. By Professor BAYLEY BALFOUR, F.R.S.

(Read 13th April 1916.)

Within the last few years there has flowered in cultivation in Europe a beautiful Chinese Rhododendron bearing the name *Rh. lacteum*, Franch. It is one of the large-leaved plants of the genus, is hardy, and produces a big truss of white flowers blotched with crimson. It was discovered in Yunnan by the Abbé Delavay, and from seeds sent by him to the Jardin des Plantes, Paris, the plants now flowering have originated. The first record of its flowering in Britain was in 1910 in the garden of Mr. F. D. Godman, South Lodge, Horsham. In France it first flowered with M. de Vilmorin at Verrières le Buisson in 1912, the flowering plant being then twenty-two years old.[1] Unfortunately the wrong name has got attached to the plant. It is not *Rh. lacteum*, Franch.[2] and the aim of this communication is to put right the nomenclature.

In 1886[3] Franchet described under the name *Rh. lacteum*, Franch. one of the first of many new Rhododendrons found by the Abbé Delavay on the Alps of Yunnan. The description runs:—

"Arbor. Folia crasse coriacea, ovato-elliptica, basi distincte cordata, supra intense viridia glabra, subtus pube pallide rufescente obducta, quasi tomentella, nervis utrinsecus 10–12. Flores 12–20 dense congesti, lactei, pedunculo elongato breviter rufo-lanuginoso; calyx minimus, dentibus obsoletis, late triangulis; corolla pollicaris, e basi late campanulata, extus glaberrima, lobis 6; stamina 12, filamentis basi scabridis, ovarium breviter et dense rufotomentellum, stylo ex toto glaberrimo.

"Yunnan, in monte Koua-la-po silvas efficiens. (Delavay, No. 164.)"

The full story on Delavay's ticket is:—"No. 164. Arbre

[1] See Mottet in Rev. Hort. (1912), 275; id. in Gard. Chron., Nov. 27, 1915. In the Botanical Magazine (1911), t. 8372, there is an error in the statement that it flowered with M. de Vilmorin in 1908.

[2] A short note stating this has appeared in the Gardeners' Chronicle of March 25, 1916.

[3] Franchet in Bull. Soc. Bot. France, xxxiii (1886), 231.

de 10 mètres. Fleurs blanc de lait. Forêt des hautes montagnes; forme presque à lui seul des forêts au sommet de Koua-la-po (Hokin). 21 Mai 1884. Leg. ipse Delavay."

In 1887[1] Franchet described under the name *Rh. lacteum*, Franch. var. *macrophyllum* another of Delavay's Rhododendrons in the following terms:—

"Folia ovato-oblonga, longe cuneiformia, usque ad 9 poll. longe subtus dense rufo-lanuginosa, flores usque 20–25 glomerato-corymbosi, corolla 4–5 cent. longa, lactea cum maculis fuscis.

"Yunnan ad collem Yen-tze-hay. Alt. 3200 m. ubi silvas efformat; fl. 23 maj. (Delav. No. 2214)."

The full story on Delavay's ticket is:—"No. 2214. Fleurs blanches avec une légère teinte lactée. Arbre de 8 à 10 mètres. Les forêts au col de Yen-tze-hay (Lankong) à 3200 m. d'alt. 31 Mai 1886. Legit Delavay."

I am under special obligation to M. Lecomte, Director of the Botanical Department in the Jardin des Plantes, Paris, for having given me the privilege of examining Franchet's type specimens (Delavay's Nos. 164 and 2214) preserved at Paris, and from them I have transcribed above Delavay's original tickets. In addition to these type specimens M. Lecomte has been so good as to send me a third sheet of specimens collected by Delavay and named *Rh. lacteum*, Franch. on the sheet by Franchet. Delavay's ticket on this specimen reads:—"Rhododendron No. 2794. Fleur jaune soufre. Arbrisseau de 2 mètres parmi les broussailles sur le Tsong-chan au-dessus de Tali à 4000 m. d'alt. Le 27 Juin 1887. Legit ipse J. M. Delavay." This plant is certainly of the same species as *Rh. lacteum*, Franch., Delavay No. 164.

In addition to these Paris specimens I have had for examination the collections made by Mr. Forrest in Yunnan during his several years of exploration and presented to the Royal Botanic Garden, Edinburgh, by Mr. A. K. Bulley and by Mr. J. C. Williams. Amongst these I find the following, which correspond with Delavay's Nos. 214 and 2794 and are *Rh. lacteum*, Franch.:—

Yunnan. In and on the margins of pine forests on the eastern flank of the Tali Range. Lat. 25° 40′ N. Alt.

[1] Franchet in Bull. Soc. Bot. France, xxxiv (1887), 280.

12,000 ft. Shrub of 15–25 ft. Flowers pale yellow. Forrest No. 4160. Aug. 1906

Yunnan. Rhododendron forest. Eastern flank of the Tali Range. Lat. 25° 40′ N. Alt. 12,000 ft. Tree of 20–30 ft Flowers pale yellow, fragrant Forrest No. 6778. Aug. 1910.

Yunnan. Rhododendron forests. Western flank of the Tali Range Lat. 25° 40′ N. A shrub of 15–25 ft. Alt. 12,000 ft. Flowers pure canary yellow. Forrest No. 11,575. June 1913.

And then there are the following specimens, which are certainly the same as Delavay's No. 2214 and are therefore *Rh. lacteum*, var. *macrophyllum*, Franch.:—

Yunnan. Above the pine belt on the Sung Kwei—Lang Kung divide. Lat. 26° N. Alt. 13,000–14,000 ft. Forrest No. 501. Dec. 1904

Yunnan. Open situations in pine forests on the descent from the Sung Kwei pass to the Sung Kwei valley. Lat 26° 15′ N Alt. 10,000–11,000 ft. Tree of 20–30 ft. Flowers white fleshy with a blotch of rich crimson at base of corolla. Forrest No. 2159. April 1906.

Careful examination of this material shows to me that the differences separating *Rh. lacteum*, var. *macrophyllum*, Franch. from *Rh. lacteum*, Franch. are more than varietal and that we have before us here two quite distinct species.

Apart from many minor differences there are two characters by which *Rh. lacteum*, Franch. and *Rh. lacteum*, var. *macrophyllum*, Franch can be readily distinguished one from the other. These are:

a. The indumentum of the under surface of the leaf:—

Genuine student as he was of Rhododendrons, Franchet came to recognise the importance of the indumentum as a diagnostic mark within the genus, and as bearing upon the immediate subject of discussion here I quote from one of the pregnant notes which he usually attached to his diagnoses of species after the earlier ones. Writing of *Rh. sanguineum*, Franch. he says:—"La couche crustacée qu'on observe à la face inférieure des feuilles de quelques Rhododendron n'est souvent que la strate inférieure d'un veritable tomentum; mais dans le *Rh. sanguineum* ainsi que dans le *Rh. lacteum* et quelques autres, l'indument

laineux fait réellement défaut." This states a critical difference recognisable at sight betwixt *Rh. lacteum*, Franch. and *Rh. lacteum*, var. *macrophyllum*, Franch.

The indumentum of *Rh. lacteum*, Franch. forms a uniform smooth velvety dull fawn-coloured covering to the leaf under surface and when looked at closely shows prismatic scintillate points all over. It is composed of tufts of hair-cells. Each tuft has a very short base of attachment the cells of which have a yellow-brown content. From the base spread out thin-walled unicellular branches, some four or five, of no great length. They are wide and empty, somewhat vesicular, and colourless. These tufts are close set and their branches closely interlock. The walls of these cells give the prismatic reflections on the surface of the indumentum. Many tufts form one stratum of indumentum.

In *Rh. lacteum*, var. *macrophyllum*, Franch. the indumentum of the under surface of the leaves produces a hazel-brown covering which under moderate magnification —even to the unaided eye—appears to be coarsely pitted. It is not smooth and velvety but somewhat fluffy and does not show prismatic scintillations. It is composed of cup-shaped scales each with a definite many-celled stalk expanding into a membranous cup one cell thick showing a network of the walls of the component cells. The rim of the cup is undulate and runs out at points into long tortuous threads which are intricately woven between the mouth of the cups. The tint of the cells of the cups gives the colour of the indumentum. But these cup-shaped cells at the surface of the indumentum are not the only ones. Beneath these and of all sizes down to quite few-celled almost unformed ones are other colourless scale hairs which, when as often happens the brown scales of the free indumentum surface fall off, appear as a greyish lower stratum of indumentum taking the place of the scales removed. The indumentum here is then of more than one stratum.

In the ordinary language of systematists the covering would be called a tomentum in both cases and the under surface of the leaf be described as tomentose. But in the genus *Rhododendron* there are many kinds of indumenta

that would come under the designation tomentose which differ markedly in construction and are useful diagnostic marks. I may here direct attention to a short paper by Miss E. M. Jesson[1] dealing with the indumentum of *Rh. Falconeri*, Hook. f. and *Rh. Hodgsoni*, Hook. f. in which the diagnostic value of the indumentum is clearly pointed out.

The indumentum of the ovary in *Rh. lacteum*, Franch. and *Rh. lacteum*, var. *macrophyllum*, Franch. is of the same character composed of fasciated longer or shorter hairs.

b. The colour of the flower:—

The colour of the flower in *Rh. lacteum*, Franch. is variously described by the collectors as "blanc de lait," "jaune soufre," "pale yellow," "pure canary yellow." In one of Mr. Forrest's specimens the dried flowers show quite a yellow tint. Franchet uses the word "lactée."

The flowers of *Rh. lacteum*, var. *macrophyllum*, Franch. are described by collectors as "blanches avec une légère teinte lactée," "white with a blotch of rich crimson at base." Franchet says: "corolla lactea cum maculis fuscis." In all the dried specimens the blotch is evident.

One concludes from the evidence that the flower in *Rh. lacteum*, Franch. has always a yellow tint becoming bright yellow at times and there is no crimson blotching *Rh. lacteum*, var. *macrophyllum*, Franch. has white flowers sometimes creamy white and with a crimson blotch. It is this *Rh. lacteum*, var *macrophyllum*, Franch. which has come into cultivation under the name *Rh. lacteum*, Franch. How did the name *lacteum* become attached to it?

In 1889[2] Hemsley cited *Rh. lacteum*, Franch. as a species of the Chinese Flora in his Enumeration, but he makes no special reference to *Rh. lacteum*, var. *macrophyllum*, Franch. published in 1887. He must have known of the variety, for his reference to Chinese localities for the species runs—"Yunnan: a tree forming woods on the Koulapo Mountains and on Yengtzehay near Lankong at 3200 metres (*Delavay*)," and "Koulapo" is the station given by

[1] Jesson in Ann. of Botany, xxix (1915), 635.
[2] Hemsley in Journ. Linn. Soc., xxvi (1889), 26.

Franchet for *Rh. lacteum*, Franch., Yeng-tze-hay the station for *Rh. lacteum*, var. *macrophyllum*, Franch. The specimens are cited from Herb. Kew. I must think that Hemsley did not devote critical examination to the plants. He is far too acute a botanist to miss the distinctions.

Subsequently in 1911 when he described in the Botanical Magazine under t. 8372 as *Rh. lacteum*. Franch. a plant—really *Rh. lacteum*, var. *macrophyllum*, Franch.—the figure of which was derived from a flowering specimen in the garden of Mr. F. D. Godman at South Lodge, Horsham—he took the same attitude. There is no reference to Franchet's variety. This as a criticism of Franchet's work was dangerous

I have had occasion to follow along the path which Franchet trod in several fields, and the experience has always increased my admiration of his perspicacity and of the accuracy of his work. When Franchet names a varietal form within a species one may have confidence that there is a valid differential feature in the forms he deals with—different though its value be in the eyes of botanists. Franchet's attitude was conservative. Observe how he is always endeavouring to bring the Chinese novelties with which he is dealing within the limits of a specific type already known from the Himalayas. He preferred to extend the limits of a species rather than to break up an aggregate. The case before us illustrates his extension of specific limits beyond what is natural, and what I believe he himself would have allowed had he lived to publish the fuller account of the species of which these earlier descriptions were only preliminary diagnoses. For there is no doubt about it—*Rh. lacteum*, Franch. is one species, *Rh. lacteum*, Franch. var. *macrophyllum* is another.

Rh. lacteum, Franch. is apparently rare, *Rh. lacteum*, var. *macrophyllum*, Franch. more common, and the latter it is of which the seed came to Europe from Delavay and from which the plants that have flowered in cultivation have been derived Its varietal name having been ignored it has usurped the specific one.

Diels also misunderstood the *Rh. lacteum*, Franch. In 1912, accepting an identification I had made at Paris in 1906 of Forrest's No. 501 as *Rh. lacteum*, Franch. var.

macrophyllum, Diels[1] took Forrest's No. 2159 to be the true *Rh. lacteum*, Franch. adding however, "I do not think that *macrophyllum*, Franch. is even a variety. The size of leaves seems to be a fluctuating character in these two." From his standpoint, looking on Forrest's No. 2159 as *Rh. lacteum*, Franch. and Forrest's No. 501 as *Rh. lacteum*, var. *macrophyllum*, Franch. Diels is right. These plants are the same but then neither of them is *Rh. lacteum*, Franch. They are both *Rh. lacteum*, Franch. var. *macrophyllum.*

Yet Diels had under his eye the true *Rh. lacteum* Franch. in Forrest's specimens 4160, which he placed[2] in *Rh. taliense*, Franch. It is however far removed from this species.

Franchet's two plants being distinct species it is necessary to give his var. *macrophyllum* a distinguishing name. There is already a *Rh. macrophyllum*, Don—a N.W. American species—and I have to christen the plant as I do under the name *Rh. fictolacteum*, Balf. fil.

Rh. lacteum, Franch. gives promise of being a more welcome plant in our gardens than *Rh. fictolacteum*, Balf. fil. A large-leaved Rhododendron with large trusses of canary-yellow flowers will indeed be an acquisition. Seeds of the plants in its finest form as shown in dried specimens have been procured by Mr. Forrest (No. 11,575) from which we may have it in cultivation and I hope flowering at an earlier period in its life than *Rh. fictolacteum*, Balf. fil

The description attached to t. 8372 of the Botanical Magazine may be taken as that of *Rh fictolacteum*, Balf. f as it appears in cultivation, and we must await the flowering in our gardens of *Rh. lacteum*, Franch for a full description of it for comparison with its ally. Here I content myself by crystallising in the following brief differential diagnosis what is said above:—

Rh. lacteum, Franch. Leaves not tapered to base. Under leaf indumentum unistrate smooth velvety uniform dull fawn coloured of persistent hair tufts each on a short foot. Flowers cream coloured to canary yellow.

Rh. fictolacteum, Balf. f. Leaves tapered to base.

[1] Diels in Notes R.B.G. Edin., v (1912), 215.
[2] Diels in Notes R.B.G. Edin., v (1912), 216.

Under leaf indumentum bistrate. Surface pitted not smooth hazel brown of long-stalked cup scales with fringing long hairs often deciduous and uncovering a lower series of colourless scales. Flowers white blotched crimson.

Since my note appeared in the Gardeners' Chronicle, March 25, 1916, I have been asked the question by Sir Edmund Loder, Bart.—What is *Rh. lacteum*, Franch. mentioned by Rehder and Wilson ?[1] and he has kindly sent me a leaf of this plant grown at Leonardslee under Wilson's number 4254. I have also received a leaf of the same plant from Lieut. Commander Millais who is engaged in preparing a monograph of the genus *Rhododendron*. A glance at the indumentum of the leaf suffices to tell that Wilson's No. 4254 is not *Rh. lacteum*, Franch A more careful analysis tells that it is not *Rh. pctolacteum*, Balf. fil. I must point out however that Rehder and Wilson say of their " specimens which are in ripe fruit only " that they "appear to be identical with Franchet's plant." What the plant is may be determined when it flowers. I expect it will prove to be a new species. I have seen no specimens of Wilson's 3431.

A HYBRID POTAMOGETON NEW TO THE BRITISH ISLES

By ARTHUR BENNETT, A.L.S.

(Read 13th April 1916.)

In August 1915 Messrs. Barclay and Matthews sent me some gatherings of *Potamogeton* from the river Earn, near Dunning, in mid. Perth, V.C. 88. They included *P. decipiens*, Nolte, *P. crispus*, Linn., and many specimens of ×*P. venustus*, Baagve=*P. crispus* × *alpinus*, Balb. This rare hybrid has only been recorded from Denmark, and was found there by Herr Baagve in the river Gudenå, in Jyllandia, and the river Vigersdalå, in Saellandia, in 1879.

The Scottish specimens are of the two nearer *crispus*, while the Danish ones are about half-way between the two species. At this date no *alpinus* was gathered, but *alpinus* is on record for the Earn from near Dupplin and Forteviot,

[1] Rehder and Wilson, Plantae Wilsonianae, i (1913), 545.

the latter place being three miles further down the river than Dunning. But Mr. Barclay wrote me: "I have little doubt it will be found at or above the place of the hybrid, and I hope to search for it there."

× *P. venustus* was published by Baagve in Compt. rend. (Congrès de botanique), Paris, p. 517, 1900.

P. crispus × *alpinus*, Baagve, in litt. et sp.

P. alpinus × *crispus*, Asch. et Graeb., in Engler, Pflanzenr., iv. 11 (1907), pp 132 and 162; and on page 72 they refer to it under *P. alpinus*, var. *undulatus*, Fischer (but the margins are not undulated or serrated); and Asch. et Graeb. in Syn. Flora Mitt. Europas, ed. 2 (1913), p. 515.

The two German authors make a point of reversing the names in hybrids, though the sequence given by the authors of the hybrids was no doubt intentional.

TRANSACTIONS

OF THE

BOTANICAL SOCIETY OF EDINBURGH.

SESSION LXXXI.

On the Affinities of Sedum Praegerianum, W. W. Sm., with a Tentative Classification of the Section Rhodiola. By R. Lloyd Praeger, B.A. (Plates II–IV.)

(Read 8th February 1917.)

Sedum Praegerianum, W. W. Sm. (Plate II, figs. 1-3), collected in the Chumbi Valley, Tibet, in 1912, and in cultivation at Edinburgh (and, by the kindness of Professor I. Bayley Balfour, in my own garden), presents several features which, singly or in combination, are unusual in the genus to which it belongs. The erect root-stock is very short, and does not lengthen appeciably with age; it produces, below, thick fleshy roots recalling those of the Rhodiola section, and, above, a flat rosette of stalked lanceolate entire leaves, which fade in autumn. From the axils of these leaves the flowering-shoots develop in summer. these latter are prostrate, slender, and leafy, and terminate in a loose cyme of rosy flowers which are egg-shaped (fig. 2), the petals being very erect and almost touching at the tips.

As stated above, the root-stock, in spite of its abbreviated form, recalls that of the Rhodiola section, in which it is always thickened and usually elongate. The rosette of leaves which crowns the short root-stock is very unusual, and in the genus is found chiefly in certain annual or biennial species, such as the European *S. Cepaea*, Linn., the Caucasian Sempervivoides group, and some of the

Chinese annuals, with none of which *S. Praegerianum* has any affinity. But a closer parallel among species which, being in cultivation, are fully available for comparison, is found in *S. primuloides*, Franchet, one of Delavay's Yunnan plants, now well known in gardens (Plate III, fig. 4). In *S primuloides* similar rosettes of entire stalked leaves (in this case ovate, fig. 6) are found, but in *S. primuloides* the root-stock is slenderer, much-branched, and aerial, forming a tiny bush, each branch with a terminal leaf-rosette. Next, the axillary flower-stems of *S. Praegerianum* are most unusual in the genus, but are again exactly matched in *S. primuloides*, which agrees further in its ovoid flowers (fig. 5); this last feature, also very unusual in Sedum, is on the other hand approached in a few of the Rhodiolas—for instance, in *S. rariflorum*, N. E. Br., a recently described Chinese species (fig. 7). So that the affinities of *S. Praegerianum* appear to lie with the Rhodiola section on the one hand, and more directly with *S. primuloides* on the other.

An examination of *S. Praegerianum* reveals another feature unusual in Sedum. The petiole widens at the base to three or four times its normal diameter (fig. 3), and is attached to the root-stock by the whole breadth of this expansion, so that the cicatrix produced by removing a leaf is a horizontal line running round a considerable arc of the periphery of the root-stock. To find an analogue to this, we turn again to *S. primuloides*, where a precisely similar form of leaf-base is found (fig. 6). It seems clear, then, that there is a close affinity between *S. Praegerianum* and *S. primuloides*; but where are these two aberrant species to be placed in a classification of the genus?

The points of resemblance between *S. Praegerianum* and the Rhodiola section of Sedum have been pointed out already. Rhodiola, as established as a genus by Linnaeus (Genera Plantarum, ed. i, p. 318, 1737), envisaged only those plants, now usually placed under Sedum, which have dioecious, tetramerous flowers. Scopoli (Introd. ad Hist. Nat., 255, 1777) employed the term in the same sense, as a section of Sedum. As knowledge of these plants increased, it became clear that in a hard-and-fast sense this definition could not stand, as closely allied plants

were found, some of them not even specifically distinct (in the ordinary sense) from true Rhodiolas, and all having the characteristic Rhodiola facies, which were pentamerous, and polygamous or hermaphrodite. The Linnaean definition, in fact, did not separate out a natural group. A better definition was clearly to be based on the growth-form—the thick caudex crowned with scales from the axils of which arise simple leafy annual flower-stems, whether these flowers are dioecious and tetramerous (these two characters generally, but not always, going together), as in *S. roseum*, Scop. (*S. Rhodiola*, DC.), *S. elongatum*, Wall., and *S. himalense*, D. Don, or hermaphrodite and pentamerous, as in *S. crassipes*, Wall. (*S. asiaticum*, auct., nec DC.), *S. linearifolium*, Royle, and *S. trifidum*, Wall. It seems better to follow Ledebour and Maximowicz in using the term Rhodiola in this wider meaning, than Boissier and Hooker (in Journ. Linn. Soc., Bot., ii, 95) who use it in its restricted sense. The growth-form referred to separates all the Rhodiolas from other Sedums. It is most nearly approached in the section Telephium and in some species of the series Aizoonta of the section Seda Genuina (*e.g.*, *S. Aizoon*, Linn. and *S. Selskyanum*, Regel), in these the caudex is thickened, and similarly gives rise to annual leafy flowering shoots; but the characteristic scale-leaves are absent, and the shoots arise either from the axils of the lowest leaves of the previous season's shoots, or from indefinite points on the caudex near the base of the former shoots.

In this wider sense, then, the section Rhodiola is characterised by its much thickened and usually elongate caudex, crowned with scales, from the axils of which arise unbranched leafy flowering shoots. In some of the more familiar members of the section, such as *S. roseum*, Scop. and its allies (*heterodontum*, H. f. et T., *Kirilowi*, Regel, etc.), these scales are not very well developed; they are short, broad, and dry and membranous from an early stage But in certain other species, belonging both to restricted Rhodiola and to that group in its wider sense, the scales are much better developed, and a study of them throws light on the question of the affinities of *S. Praegerianum*. When these Rhodiolas are mature, with

elongate aerial rhizomes which are lengthening slowly, the scales are short and crowded round the growing point; but in plants in vigorous growth, or in seedlings, they have a greater importance, and assume instructive forms. Under certain circumstances, too, such as exuberant growth, or when the rhizome is cut off below the surface of the ground, slender subterranean sucker-like branches of the root-stock are produced, whose behaviour after reaching the surface deserves attention.

Fig. 8 represents one season's growth of a vigorous aerial shoot of the root-stock of *S. fastigiatum*, H. f. et T., a typical Himalayan dioecious, tetramerous-flowered Rhodiola: for clearness, the leafy flower-shoots have been cut away. The form of the scales is seen clearly here, and it is to be noted that the younger ones are prolonged into a blunt linear tip, which is green and leaf-like. A further stage in the development of the scales is seen in fig. 9, which represents the upper part of a sucker-like shoot arising from a root-stock cut off below ground of *S. himalense*, D. Don, another dioecious, tetramerous-flowered Rhodiola from the same region. Here the scales are quite leaf-like, and form a small rosette, their broad clasping bases being prolonged upwards into green oblong laminae (fig. 10), which in texture and colour resemble the leaves of the flower-shoots. The subterranean lower scales are distant, colourless, and thin, with axillary buds which give rise to branches of the sucker; the axils of the upper aerial leaf-like scales in the following season produce flower-shoots.

Let us next take *S. crassipes*, one of the Rhodiolas with hermaphrodite 5-parted flowers and an elongate root-stock, widely spread in the Himalayan region. Fig. 11 shows a sucker similar to that last referred to, but rather older. Here the scales have the usual clasping base, and a well-developed lanceolate slightly toothed lamina (fig. 12); they are, in every sense, leaves. From their axils flower-shoots are seen rising. Below ground the scale-leaves are small; and at the apex of the shoot they have already passed beyond the leafy stage, and have adopted the crowded habit and reduced size found in the mature plant, the lamina having shrunk to a mere flat green tip.

The seedling forms of *S. crassipes* show an analogous

development.[1] Following on the two seed-leaves (seen in fig. 13) a rosette of scale-leaves similar to those just described is produced. Fig. 13 shows a seedling three months old. The next drawing (fig. 14) illustrates a plant a month older, with the first flower-shoot arising from the axil of one of the lower scale-leaves. The close similarity of these scale-leaves of *S. crassipes* to the leaves of *S. Praegerianum* does not need emphasising.

Here, then, we find the explanation of the peculiar characters of *S. Praegerianum* and *S. primuloides*—their rosettes of leaves, their clasping leaf-base and axillary flower-shoots, and their flowers akin to those of some of the hermaphrodite Rhodiolas. It seems clear that they are primitive Rhodiolas in which are still preserved the leaves which clothed the root-stock of ancestral forms; these leaves, in the majority of living species, being represented merely by membranous scales. Thus viewed, as members of the Rhodiola section, *S. Praegerianum* and *S. primuloides*, apart from their peculiar leaf-rosette, fall easily within the limits of that group as hitherto understood, which embraces a considerable variety of plant forms. The root-stocks of both, though approaching those of typical Rhodiola, are unusual—the former by reason of its extreme shortness, and the latter on account of its slenderness and repeated branching For the characters of the flower-stems, stem-leaves, inflorescence and flowers, analogues can easily be found among the Asiatic Rhodiolas.

It may be added here that among the Mexican Sedums, which show a very wide range of growth-forms, the *primuloides* type sometimes occurs—in *S. Palmeri*, S. Wats. and *S. compressum*, Rose, for instance, where leaf-rosettes borne at the ends of the branches give rise to axillary leafy flower-shoots bearing terminal cymes; in *S. nutans*, Rose (*Cremnophila nutans*, Rose), where similar axillary leafy shoots bearing large elongated panicles are produced from ample loose rosettes; and in *S. pachyphyllum*, Rose, in which the leafy axillary flower-shoot arises from a stem which is more elongate than those of the species just mentioned, and which is clothed with leaves for the greater

[1] Some account of the seedling stage of this species and of *S. roseum* will be found in Lubbock, Seedlings, i, 514–516.

part of its length. But none of these American species have the broad clasping leaf-base or the thickened root-stock of the Rhodiola section, and they have reached their present form along some other line of descent.

So far I have dealt only with species which I have had an opportunity of studying in the growing state, because these can be watched at different stages of growth, and under varying conditions. Dried material is not nearly so satisfactory among plants which vary so much and dry so badly as the group with which we are dealing. Descriptions are still less satisfactory: for instance, the clasping leaf-base, which I believe I am right in treating as of first importance, is not mentioned in the original descriptions of *S. primuloides* and *S. Praegerianum*. Nevertheless, further points regarding the questions dealt with above may be gleaned from a study of dried specimens, where available, and of the descriptions of some other species—mostly recently published—from the area extending from Afghanistan to China. Some further evidence derived from living plants is also added. Beginning at the *Praegerianum* end of the series, three species have been described by M. Raymond Hamet—*S. Hobsonii*,[1] *S. Durisi*,[2] and *S. Balfouri*[3] (the first and third from Tibet, the second from Central Asia)—which are clearly allied to *S. Praegerianum*. The descriptions are full, and I have examined the types of the first and third. In all the caudex is short, thick and erect as in *Praegerianum*, and is similarly crowned with a rosette of entire leaves, attached to the caudex by a broad clasping base. In *S. Balfouri* these leaves are sessile, linear-obovate, mucronate at the apex, very broad at the base (fig. 15). They closely resemble those specially vigorous scale-leaves of *S. himalense* (fig. 10) to which reference was made on a previous page. The axillary flower-stems of *S. Balfouri* are quite tall (over a foot), and its inflorescence and flowers recall those of *Praegerianum*. In *S. Durisi* the lamina is "obovato-suborbicularis," very obtuse, cuspidate; the indistinct petiole "latissimum, cuneiforme, basi latum." *S. Hobsonii* comes quite near *S. Praegerianum*; the leaves are

[1] Kew Bulletin, 155, 1913. Type at Kew.
[2] Bull. Soc. Bot. France, lx, 446, 1913.
[3] Notes Roy. Bot. Gard. Edin., viii, 116, 1912. Type at Edinburgh.

very similar, but smaller, ovate-oblong with a long, broadly linear petiole equalling the lamina, widening below to a very broad, deltoid-semiorbicular base; the axillary flowering-stems, flowers, and general appearance much resemble those of *S. Praegerianum*.

Next, several species have affinities with *S. primuloides*—viz. *S. pachyclados*,[1] *S. Leveilleanum*,[2] and *S. leucocarpum*[3] The habitats of these lie far apart—Afghanistan, Quelpaert, and Yunnan respectively. *S. pachyclados* (of which there are specimens at Kew) reproduces closely the growth-form of *S. primuloides*, the caudex being aerial and much-branched. The leaves (fig. 16), which are borne in terminal rosettes, are small, obovate, bluntly toothed, and the very short petiole expands into the characteristic clasping base (though not referred to in the description). The flowers are smaller, more open, and more numerous than in *S. primuloides* Of the remaining two species the descriptions are not sufficiently full for our purpose; but *S. Leveilleanum* has a thick erect caudex with dense rosettes of sessile entire cuspidate cuneiform-linear leaves ¼ inch in length, and short leafy (? axillary) flower-stems. As regards *S. leucocarpum*, the details given do not allow of a complete reconstruction of the plant, but apparently it belongs here also.

Two other species, *S. Karpelesae*, R. Hamet[4] from Tibet and *S. Levii*, R. Hamet[5] from Sikkim, appear to connect the *Praegerianum-primuloides* series with the *crassipes* type (in which the scales, at first often green and often terminated by a short narrow lamina, become later membranous and triangular or semicircular). These two species have thick (? elongate) caudices and axillary flower-stems. The inner younger scale-leaves are green and are expanded into an ovate entire stalked lamina (figs. 17, 18); when the lamina fades, the expanded base remains as a membranous scale of *crassipes* type. This shape of caudex-leaf is well matched by those of young plants of *S. Farreri*, W. W. Sm.[6]

[1] Aitchison and Hemsley, Journ. Linn. Soc. (Bot.), xviii, 58, 1880.
[2] R. Hamet in Bull. Soc. Bot. France, lv, 712, 1909.
[3] Franchet in Journ. de Bot., x, 288, 1896.
[4] Bull. Soc. Bot. France, lviii, 615, 1911.
[5] Ibid., lvi, 568, 1909.
[6] Notes Roy. Bot. Gard. Edin., ix, 125, 1916.

(fig. 19); in this species, by the end of the first year, these juvenile leaves have given place to green deltoid acute scales, like those of *S. crassipes*, *S. himalense*, etc.; a similar case is shown in fig. 20, which represents the juvenile caudex-leaf of a Chinese species (Ward, No. 764) not yet described; here also triangular scales soon replace the petiolate leaves of the young plant.

Compare also the long-stalked orbicular seedling-leaves of *S. bupleuroides* (fig. 21). This species is one of the small-scaled *roseum* series; the seedling, after producing about three of these leaves[1] during the first few months of its life, abruptly exchanges them for quite insignificant brown scales (figs. 22, 23).

Leaving now those species which in the mature state possess caudex leaves with a petiole and distinct lamina, there follows a large group, showing considerable diversity of habit, leaf, and flower, but agreeing in its thick, mostly elongate caudex, well-developed scales often prolonged while young into a short, narrow, green lamina, and flowers (as in the preceding groups), hermaphrodite and 5-parted. The old scales are membranous, the old flower-stems often persistent, the carpels usually slender and erect, with slender erect styles. The familiar *S. crassipes*, Wall. (*S. asiaticum*, Clarke nec DC.) may be taken as a type. Some twenty species, which range from the Himalayas to China, may be placed here. The well-known and peculiar Himalayan *S. trifidum*, Wall. seems to fit best with this group, although in its scales it comes nearer the *roseum* group referred to below.

We arrive now at Rhodiola *sensu stricto*—a group differing from the last in its usually 4-parted dioecious flowers, with short carpels crowned with short styles which are reflexed in fruit. The plants which belong here divide themselves into two tolerably well-marked groups:—*S. himalense*, D. Don and allied species on the one hand, with well-developed scales resembling those of the *crassipes* group, and old stems usually persistent; and, on the other hand, the familiar *S. roseum*, Scop. and its allies, with poorly-developed scales and deciduous flower-stems.

[1] It may be noted that the expanded base of the seedling-leaves of *S. bupleuroides* is suffused with purple, precisely as in *S. primuloides*.

The considerations put forward in the preceding pages point to the definition and classification of the section Rhodiola which is given below. The great variability of many of the species (see Hooker and Thomson in Journ. Linn. Soc. (Bot.), ii, 93–95) makes precise classification difficult. Furthermore, in the case of some of the species of which specimens are not available to me, the descriptions are not sufficiently full to allow of their being placed with certainty. I have marked with an asterisk the species which I have had an opportunity of studying in the living state: the placing of some of the remainder must be regarded as tentative. I have put a ? before one or two species of the position of which I am doubtful.

Certain species, as is to be expected in so puzzling an assortment of forms as the Rhodiolas are difficult to place, because they are intermediate between two groups, or boldly combine certain characters of two. Thus, *S. trifidum* has the small scales and deciduous stems of the *Roseae*, and the 5-parted hermaphrodite flowers and slender carpels of the *Crassipedes*. *S. discolor* bears short carpels and short styles spreading in fruit of *Roseae* type in hermaphrodite flowers like those of the *Crassipedes*. *S. Smithi*, in its linear scales ending in a long subterete tail, links the *Crassipedes* with *S. Karpelesae* and *S. Levii*, belonging to the Primuloides series.

Genus *SEDUM*.

Section RHODIOLA.

Caudex fleshy, crowned with leaves with a broad clasping base (often reduced to membranous deltoid or semi-orbicular scales, or becoming so with age), from the axils of which leafy flowering shoots are produced.

Series 1. RHODIOLAE *sensu stricto*.

Flowers usually unisexual and 4-parted, caudex usually elongate or greatly thickened. Carpels usually short and crowned with short styles reflexed in fruit.

Group 1. ROSEAE.—Caudex-leaves scale-like, short, membranous, not green even when young. Old flower-stems not persistent.

**bupleuroides*, Wall.
crenulatum, H. f. et T.
Cretini, R. Hamet.
**elongatum*, Wall.
gelidum, Ledeb.
**heterodontum*, H. f. et T.
**Kirilowi*, Regel.
**longicaule*, Praeger.
**purpureo-viride*, Praeger.
**roseum*, Scop.[1]
rotundatum, Hemsl.
Stapfii, R. Hamet.
suboppositum, Maxim.

Group 2. HIMALENSES.—Caudex-leaves scale-like, usually green and fleshy when young, often prolonged into a short narrow lamina or cauda. Old flower-stems usually persistent.

algidum, Ledeb.
Bouvieri, R. Hamet.
coriaceum, Wall
**fastigiatum*, H f. et T.
**himalense*, D. Don.
humile, H. f. et T.
quadrifidum, Pallas.
**tibeticum*, H. f. et T.

Series 2. CRASSIPEDES.

Flowers hermaphrodite and 5-parted. Caudex elongate or greatly thickened. Caudex-leaves scale-like, usually green and fleshy when young, often prolonged into a short narrow lamina or cauda. Old flower-stems persistent or deciduous. Carpels usually slender and crowned with slender styles not reflexed in fruit.

**crassipes*, Wall
discolor, Franch.
dumulosum, Franch
euphorbioides, Schlecht.
**Farreri*, W. W. Sm.
Levinae, R. Hamet.
linearifolium, Royle.
macrolepis, Franch.
nobile, Franch.
Praini, R Hamet
**rariflorum*, N. E. Br.
Rendlei, R. Hamet.
**rhodanthum*, A. Gray.
scabridum, Franch.
**Semenovii*, Masters.
Smithii, R. Hamet.
**Stephani*, Cham.
Tieghemi, R. Hamet.
**trifidum*, Wall.

Series 3. PRIMULOIDES.

Flowers hermaphrodite and 5-parted. Caudex slender elongate, or short not much thickened (comparatively). Caudex-leaves leaf-like, with a distinct lamina, usually petiolate.

Group 1. LONGICAULES—Root-stock elongate, much branched.

leucocarpum, Franch.
Leveilleanum, R. Hamet.
pachyclados, Aitch. et Hemsl.
**primuloides*, Franch.

[1] Including the several North American "species" of Rhodiola, which appear to be no better entitled to specific rank than many of the Eurasian forms of this polymorphic species.

Group 2. BREVICAULES.—Root-stock very short, branched slightly or not at all.

Balfouri, R. Hamet.	*Levii*, R. Hamet.
Dumsi, R. Hamet.	?*Mossii*, R. Hamet.[1]
Hobsonii, R. Hamet.	**Praegerianum*, W. W. Sm.
Karpelesae, R. Hamet.	

According to the views brought forward above, the oldest type of Rhodiola now living is represented by *S. Praegerianum*, with short caudex and large caudex-leaves. Thence a complicated series of forms shows a progressive increase in length and thickness of caudex and decrease in size of the caudex-leaves; *S. primuloides*, *S. Levii*, *S Smithii*, for instance, being progressive steps to the *crassipes* type, where the caudex-leaves, now reduced to mere scales at the summit of aerial succulent root-stocks, still show when young a green, leaf-like colour and a tendency to an incipient (or rather relict) lamina. At this point in the series the flowers, hitherto perfect and pentamerous, begin to show a tendency to dioecism and tetramerism, which becomes more pronounced as caudex development increases and scale development weakens, till in *S. roseum* and its allies we have a group of species with massive caudices crowned with small chaffy scales, from the axils of which rise strong stems bearing corymbs of dioecious tetramerous flowers. It is important to note that seedlings throughout the whole series, from *Praegerianum* to *roseum* (so far as I have had an opportunity of studying them), show what is here taken to be the primitive type of caudex-leaf—a leaf having a lanceolate to orbicular lamina, and a petiole with a broad clasping base. The different types of leaves found still persisting among the primitive *Primuloides* series can be matched, often with a remarkable closeness, in the seedling stage of members of the Crassipedes, Himalenses, and Roseae, the mature plants of which bear only scales.

As regards the question of the geographical distribution of the plants dealt with above, the Rhodiolas are essentially an Asiatic group. One species only (the N. American *S. rhodanthum*, A. Gray) does not occur in Asia; and only one other (*S. roseum*, Scop.), which is also the most variable

[1] Caudex missing in the type specimens. Appears to be allied to *S. Balfouri*.

of the whole section, spreads beyond the confines of Asia, ranging from Japan to Ireland, Greenland, and across N. America. The groups of species into which Rhodiola has been divided above show more or less well-marked centres of distribution, sometimes contradicted (as is so often the case when one is dealing with distributional problems) by some notable exception.

Series RHODIOLAE *sensu stricto*.—Of some twenty species, rather more than half are Himalayan plants, and almost all of these are confined to that region; but one of them (*S. roseum*) is the most widespread of all the Rhodiolas. Four have a wide range over Central and Eastern Asia, two are confined to Tibet, and two to Western China.

Series CRASSIPEDES.—Of nineteen species, eight are Chinese (mainly Yunnan), five Himalayan, four come from Siberia, Turkestan or Tibet; and one (*S. rhodanthum*) from Western N. America.

Series PRIMULOIDES.—The Longicaules group have their homes far apart—one in Afghanistan, two in Yunnan, and one in Quelpaert; while of the Brevicaules, four come from Tibet, one from the Himalayas, one from Central Asia, and one from China.

Roughly speaking, half the Roseae are confined to the Himalayan region, half the Crassipedes to China, and half the Primuloides to Tibet. if we take those three regions as constituting a single area, we find that to that area are confined about three-fourths of the Roseae and Crassipedes, and practically the whole of the Primuloides· in other words, nearly four-fifths of the whole section Rhodiola.

DESCRIPTION OF PLATES.

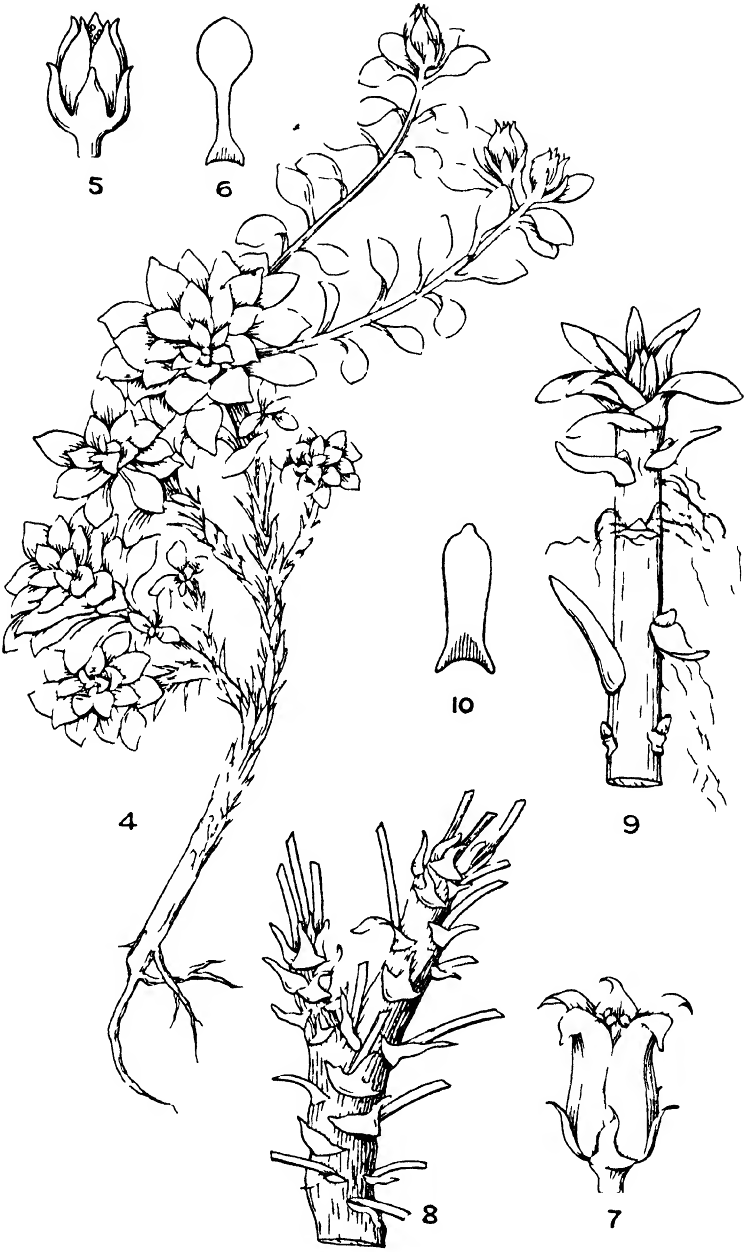
PLATE II.

FIG.	1.	*Sedum Praegerianum*,	$\frac{1}{1}$.
„	2.	„ „	flower and bud. $\frac{2}{1}$.
„	3.	„ „	leaf. $\frac{1}{1}$.

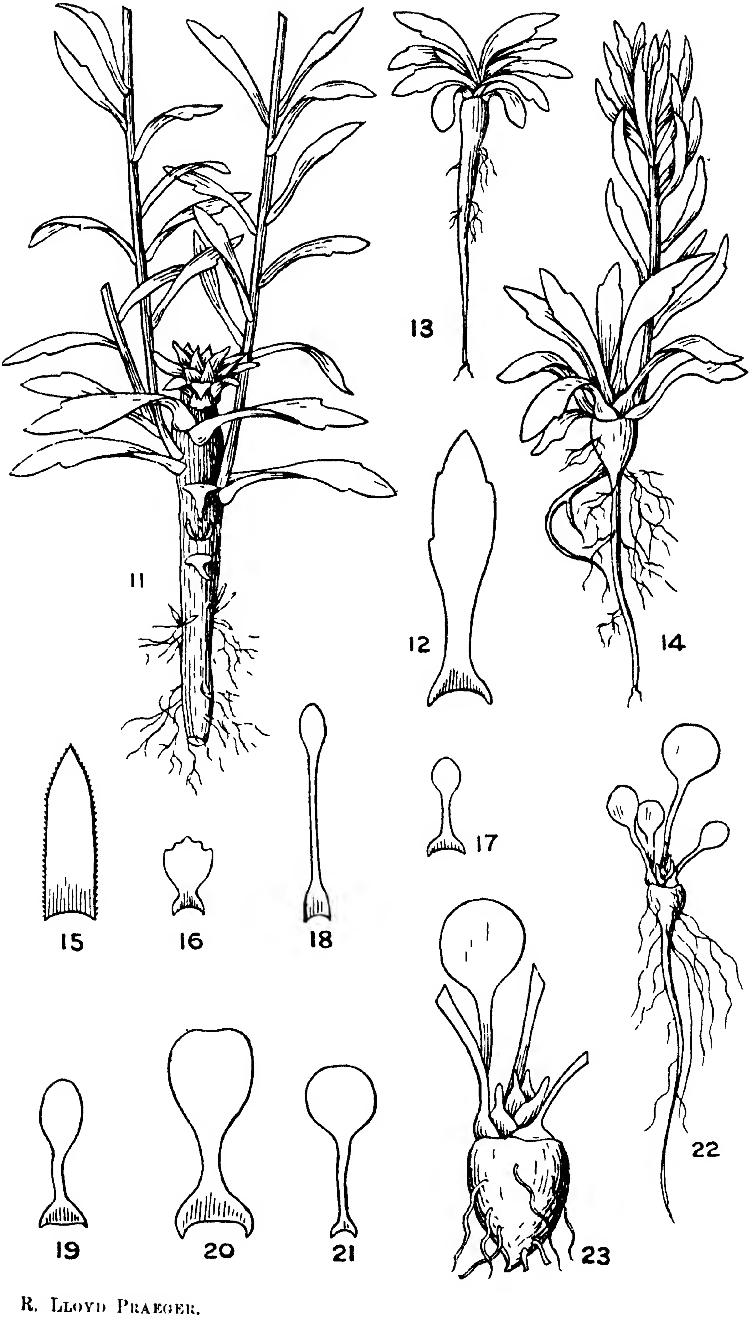
PLATE III.

FIG	4.	*Sedum primuloides*,	$\frac{1}{1}$.
„	5.	„ „	flower. $\frac{2}{1}$.
„	6.	„ „	leaf. $\frac{1}{1}$
„	7.	*Sedum rariflorum*,	flower. $\frac{2}{1}$.
„	8.	*Sedum fastigiatum*,	vigorous caudex branch. $\frac{1}{1}$.
„	9.	*Sedum himalense*,	sucker. $\frac{1\frac{1}{2}}{1}$.
„	10.	„ „	„ , leaf of same. $\frac{1\frac{1}{2}}{1}$.

R. Lloyd Praeger.



R Lloyd Praeger



R. LLOYD PRAEGER.

PLATE IV.

FIG. 11.	*Sedum crassipes*,	sucker. $\frac{1\frac{1}{2}}{1}$.
„ 12	„ „	„ , caudex-leaf of same. $\frac{2}{1}$.
„ 13.	„ „	seedling, three months. $\frac{1\frac{1}{2}}{1}$.
„ 14.	„ „	„ , four months. $\frac{1\frac{1}{2}}{1}$.
„ 15.	*Sedum Balfouri*,	leaf of rosette, after drawing by R. Hamet in Herb. Edinburgh $\frac{1}{1}$.
„ 16.	*Sedum pachyclados*,	leaf of rosette. $\frac{1}{1}$.
„ 17.	*Sedum Karpelesae*,	leaf of rosette, after R. Hamet's description. $\frac{2}{1}$.
„ 18.	*Sedum Levii*,	leaf of rosette, after R. Hamet's description. $\frac{2}{1}$.
„ 19.	*Sedum Farreri*,	caudex-leaf of seedling. $\frac{1}{1}$.
„ 20.	*Sedum* sp. (Ward, 764)	caudex-leaf of young plant. $\frac{1}{1}$.
„ 21.	*Sedum bupleuroides*,	caudex-leaf of seedling. $\frac{1}{1}$.
„ 22.	„ „	seedling, four months $\frac{1}{1}$.
„ 23	„ „	„ , growing point of same specimen. $\frac{3}{1}$.

CAVEA: A NEW GENUS OF THE COMPOSITAE FROM THE EAST HIMALAYA. By W. W. SMITH, M.A., and JAMES SMALL, M.Sc. (Plate V.)

(Read 12th October 1916.)

Cavea, W. W. Sm. et J. Small. Genus nov. *Compositarum.* Genus *Inuloidearum*; in schemate Benthamiano apud *Plucheineas* ponendum; prope *Plucheam* interim melius allocatum a qua habitu, inflorescentia, receptaculo abunde differt; ab *Inuloideis* aliis aliquatenus remotum; certe habitu *Saussuream* vel *Berardiam* simulat sed characteres florales haud conveniunt.

Herba perennis. Caules solitarii vel bini subscaposi plus minusve foliosi capitulum unicum gerentes. Folia alterna dentata vel denticulata. Capitula magna heterogama subglobosa floribus exterioribus ♀ multiseriatis fertilibus, floribus disci ☿ circ. 20–30 sterilibus. Involucri phylla multiseriata imbricata lanceolata vel lineari-oblonga exteriora herbacea interiora plus minusve scariosa. Receptaculum convexum fimbrillatum. Corollae pallido-purpureae vel sordide albidae. Corollae ♀ filiformes, stylo suo longiores, apice 3–4-denticulatae; corollae ☿ regulares tubulosae alte 5-lobae. Antherae basi breviter atque

obtusiuscule appendiculatae appendicibus contiguis plus minusve connatis. Styli florum ♀ filiformes bifidi ad margines papillosi; styli florum ☿ indivisi extus papillosi. Achaenia parva compressiuscula obscure quadrangula dense villosa. Pappi nitide purpurei setae plurimae uniseriatae scabridae nec plumosae; in floribus sterilibus pappus exiguus achaeniis abortivis glabris.

Genus monotypicum montium himalaicorum prope fines tibeticos incola.

Cavea tanguensis, W. W. Sm. et J. Small. Comb. nov.

Saussurea tanguensis, J. R Drummond in Kew Bull. (1910), 78; Smith and Cave in Rec. Bot. Surv. Ind., iv (1911), 212.

India:—Sikkim, near the Tibetan frontier; hill behind Tangu bungalow, 4920 m., Younghusband, without number in Herb. Kew and Herb. Calc.; Thé La, 4600 m., Smith and Cave, No. 2161 in Herb. Kew and Herb. Calc.; Jongsong La valley, 5080 m., Smith and Cave, No. 2357 in Herb. Kew and Herb Calc.

This interesting plant was discovered in the north-west corner of Sikkim near the Tibet frontier at an altitude of over 15,000 feet, and very near the limit of vegetation for the area. Its habitat is generally loose, shingly screes One of the dominant genera of the area is *Saussurea*, and *Cavea* has much in common as regards habit with several of the Himalayan species of that genus. Its position in or near the *Plucheineae* is, in our present knowledge, where we find we must put it on the characters presented, but the authors realise that such a position may not be its natural one. It has been with hesitation that this extreme alpine has been associated with *Pluchea*, *Blumea*, and *Laggera*. If the characters permitted, its placing near *Saussurea* or *Berardia* would have been more satisfactory from the *facies* of the plant. The generic name attached to the plant is in honour of Mr. George Cave, Curator of the Lloyd Botanic Garden at Darjeeling, an indefatigable traveller and collector over the whole of Sikkim, and one to whom the discovery of many new plants is due.

The plant was first described by Mr. J. R. Drummond from material collected by Sir F. Younghusband while

engaged on the Tibet Frontier Commission. The flowers of the first collections were unfortunately damaged by weevils and did not afford sufficient data for critical examination. It was consequently taken to be a singular species of *Saussurea*, with *S. Thomsoni*, Clarke and *S. bracteata*, Decaisne as its nearest allies. More satisfactory material now available gives the following characters, which do not accord well with *Saussurea*:—

(1) The absence of the typical ring of hairs below the stigmatic region; (2) the absence of long basal appendages to the anthers; (3) the presence of filiform female florets; (4) the character of the pappus, which is scabrid or barbellato-scabrid, not plumose; (5) the villous achene; (6) the absence of paleae from the receptacle.

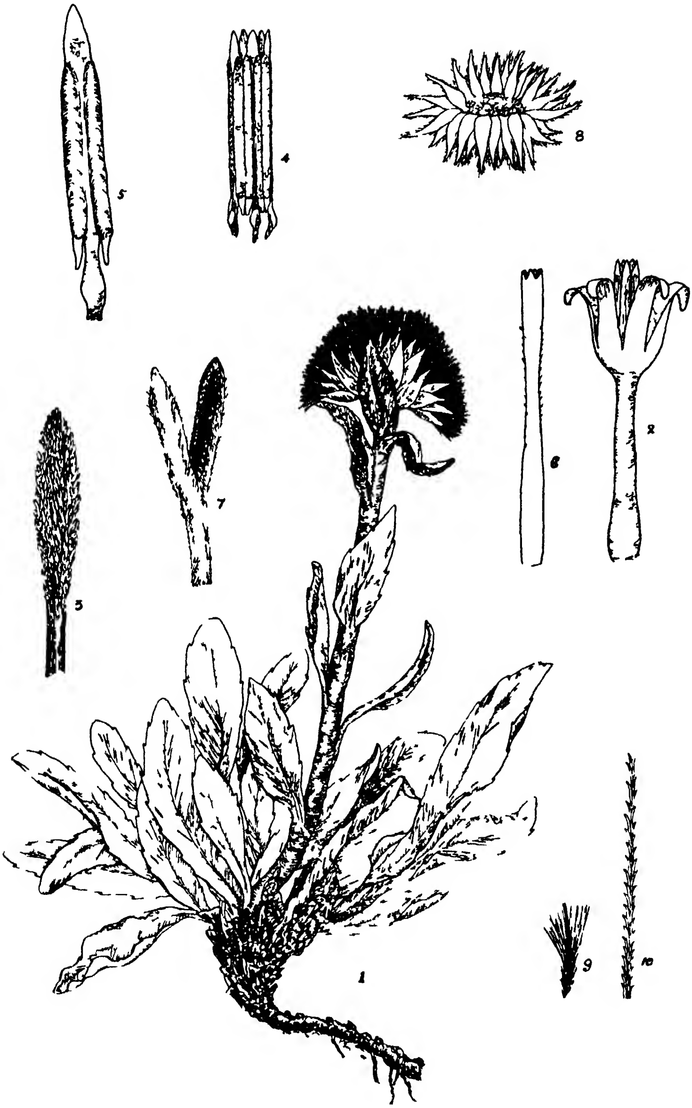
The plant is a perennial, with a slightly woody base and a rosette of lanceolate, sparsely dentate leaves. The stem is leafy, with about six small, ovato-lanceolate or ovate leaves (fig. 1). Usually the plant has only one stem, but two occur sometimes. The capitulum, which is shown in fig. 1, is compressed but is naturally subglobose. The involucral bracts are multi-seriate, lanceolate, acuminate and ciliate near the tips (fig. 8). The outer bracts are herbaceous and the inner bracts are rigid and more or less scarious. The receptacle is convex and fimbrillate (fig. 8). There are several rows of filiform florets towards the outside, and 20 to 30 male disc florets (fig. 1). These disc florets may be altogether absent. The filiform florets are female and fertile (figs. 6 and 9). The style is branched and shorter than the corolla; the style branches are flattened with rounded tips; the stigmatic papillae are marginal, extending to the apex of the branches (fig. 7). The stamens are absent. The corolla is slender, tubular, hairy on the outside near the middle, and the apex is marked by three or four small teeth (fig. 6). The pappus (fig. 9) is setose, copious, uniseriate, scabrid (fig. 10), 8–9 mm. long, and purple in colour. The mature achene is 5 mm. long, densely villous (fig. 9), and the upper hairs seem to have been mistaken by Drummond with his incomplete material for an outer series of setae. The disc florets are sterile; the aborted achene is glabrous, and the pappus consists of a few (about ten) setae. The style is undivided and papillose

on the outside (fig. 3). The stamens have the typical apical appendage and short, obtuse, basal appendages, the contiguous appendages being more or less connate (figs. 4 and 5). The corolla is tubular, regularly and deeply 5-lobed; the style is not exerted (fig. 2).

The structure of the style and stamens and the presence of filiform female florets at once suggests the *Inuleae*. According to Bentham's classification of the order the new genus falls into the sub-tribe *Plucheineae* of the *Inuleae*, and from the floral characters should be placed near *Pluchea*, from which it is distinguished by habit, receptacle, and inflorescence. A few species of *Pluchea* are herbaceous perennials, but most are shrubby. The capitulum in *Pluchea* is usually small and the inflorescence corymbose, but at least one species (*P. aromatica*, Balf. f. from Socotra) shows large capitula and a diffusely corymbose inflorescence. The receptacle is *naked* and the anther tails are *connate and acuminate* in *Pluchea*. The new genus is distinguished from *Blumea* and *Laggera* by the undivided style of the male florets, fimbrillate receptacle, general habit, and quite a few other characters; and no other genus in the *Inuleae* approaches it closely.

The large percentage of capitula with no male florets is interesting as showing a tendency to dioecism, but the most interesting point is the placing of the plant in *Saussurea* by Drummond. In Table I of a paper[1] by one of us the *Inuleae* are shown to be more closely allied in their anther appendages to the *Mutisieae* and *Cynareae* than to the tribes among which they are usually placed. The typical style of the *Inuleae* closely approaches some of the *Mutisieae* and exceptional *Cynareae*. From the study of all factors, including geographical distribution, it seems probable that the *Inuleae* gave rise to the *Cynareae* in the eastern part of the Mediterranean region, through the *Buphthalmeae*, so that it is not surprising that, in the absence of an investigation of the filiform florets, this plant should have been classed in the *Cynareae*. The absence of the ring of hairs on the style and the character of the anther appendages, however, would, even then, place it nearer the

[1] Small, J., The Pollen-presentation Mechanism in the Compositae. Annals of Botany, vol. xxix, No. cxv (1915), p. 457.



Cavea tanguensis, W. W. Sm. et J. Small.

W. W. Smith and James Small.

Gochnatieae in the *Mutisieae* (near *Berardia* in Hoffmann's classification) than in *Saussurea.*

The fimbrillate receptacle and the barbellato-scabrid setae of the pappus are interesting in view of further unpublished work by one of us, which shows that the paleae on the receptacle, *especially in the Cynareae,* may be a development of the foveolate and fimbrillate types of receptacle, while the plumose pappus is obviously derived from the simple setae by the elongation of the "barbs." Altogether the genus *Cavea* makes quite a probable, although somewhat remote, ancestor of *Saussurea* and its allies.

EXPLANATION OF PLATE V.

Fig. 1. *Cavea tanguensis,* Smith et Small, complete plant. Nat. size.
Fig. 2. Male floret, showing corolla and anther tube. × 6 circa.
Fig. 3. Upper part of style of male floret. × 15 circa.
Fig. 4. Anther tube. × 12 circa.
Fig. 5. Anther, showing apical and basal appendages. × 20 circa.
Fig. 6. Female floret, showing corolla only. × 6 circa.
Fig. 7. Upper part of style of female floret. × 15 circa.
Fig. 8. Capitulum, showing involucre and receptacle. Nat. size.
Fig. 9. Complete female floret, showing ripe achene. Nat. size.
Fig. 10. Upper part of seta of pappus. × 8 circa.

MOSSES OF WEST LOTHIAN (V.C. 84). By J. C. ADAM.

(Read 8th February 1917.)

In this paper an attempt has been made to compile a complete list of the mosses of West Lothian based upon published records, information and specimens given to me, and my own collections and observations. Very little has been published, so far as I can ascertain, regarding the moss flora of this county. Four species are recorded by Greville in his Flora Edinensis (1824), and a few others are given under the parishes of Abercorn, Ecclesmachan, and Bo'ness in the New Statistical Account of Scotland, vol. ii (1845). These have all been quoted here, but the synonomy of some of the latter is obscure, and the present existence in the county of the rarer species requires verification. In a paper by W. Bell and J. Sadler, Trans. Bot. Soc. Edinburgh, vol. x (1869), p. 251, there is a list of

mosses collected in an excursion between Manuel and Linlithgow; but as precise localities are not given, and as the excursion evidently covered ground both in Stirlingshire and Linlithgowshire, this list has not been quoted here. Some of Messrs. Bell and Sadler's specimens are, however, in the Herbarium, Royal Botanic Garden, Edinburgh, and will be found quoted as from that source. The Census Catalogue of British Mosses (1907) enumerates 166 species and varieties as occurring in V.C. 84. The sources of these records appear to have been the aforementioned works, Edinburgh Herbarium, and unpublished lists by Mr. W. Evans and Mr. J. M'Andrew. Mr. Evans and Mr. M'Andrew have kindly placed a great deal of their data at my disposal, and the definite localities for their contributions to the Census Cat. have been given here whenever known. No definite locality or reliable authority has been found for some of the Census Cat records, these have been included here and ascribed to the Census Cat. In a paper in Scot. Bot. Rev., vol. i (1912), p. 202, Mr. M'Andrew contributed 24 additions to the Census Cat. list for V.C. 84. These have been quoted here with, in some cases, amended descriptions of localities as supplied to me by Mr. M'Andrew.

The following list enumerates 216 species and varieties as compared with 190 recorded in the Census Cat. and Mr. M'Andrew's published list of additions. Doubtless additions will still be made: the Sphagna, for example, have been very imperfectly worked, and several fairly common mosses are still unknown from this county.

My own investigations in the county were pursued until the outbreak of war, in conjunction with Mr. S. E. Brock. The latter's absence on military service has prevented more recent co-operation, but a considerable amount of the material used here was gathered in our joint field-work. I am indebted to the Regius Keeper for enabling me to examine certain specimens in the Herbarium, Royal Botanic Garden, Edinburgh; to Mr Evans and Mr. M'Andrew for much kind help and information; to Mr. R. H. Meldrum and Mr. D. A. Jones for verifying many of my specimens; and to Mr. J. A. Wheldon for naming or confirming several *Sphagna* and *Hypna* (*Harpidia*).

Authorities for records are abbreviated as follows:—W. E. = W. Evans. J. M'A. = J. M'Andrew. S. E. B. = S. E. Brock. Records for which no authority is quoted are based upon material gathered by myself Records not included in the Census Cat. or M'Andrew's list of additions are marked by an asterisk.

Sphagnum cymbifolium, Ehrh. Drumshoreland Moss, J. M'A. in Scot. Bot. Rev., i, p. 204. Fauldhouse Moss, W. E.

*var. **glaucescens**, W., f **squarrosulum**, Pers Houston Wood.

S. compactum, De Cand. Drumshoreland Moss, J. M'A, l c, p. 204 (sub *S rigido*).

var. **squarrosum**, Russ Drumshoreland Moor, W. E

***S. cuspidatum**, Ehrh. Blawhorn Moss, W. E.

var. **submersum**, Schp.. f. **rigescens**, W Balvormie Wood

***S. recurvum**, P. Beauv., var **majus**, Angstr., f. **sylvaticum**. Russ Houston Wood.

S molluscum, Bruch. Drumshoreland Moss, J. M'A, l c, p 204 (sub *S. tenello*).

S. fimbriatum, Wils Drumshoreland Moss, J. M'A., l c., p. 204

S. Girgensohnii, Russ. Drumshoreland Moss, J. M'A., l.c., p. 205.

S. acutifolium, Ehrh. Blawhorn Moss; Houston Wood.

***S. crassicladum**, W., var. **diversifolium**, W Pond in Houston Wood.

***S rufescens**, Limpr., var. **albescens**, W. Houston Wood

Andreaea petrophila, Ehrh Cocklerue, W. E.

Tetraphis pellucida, Hedw Census Cat.

***T. Browniana**, Grev Parish of Bo'ness, New Stat Acc., ii, p. 125.

Catharinea undulata, Web. & Mohr. Common in damp woods, especially along the river ravines.

Polytrichum nanum, Neck. Craigie Wood, J. M'A.

P. aloides, Hedw. Drumshoreland, W .E.; abundant on the banks of Breich Water; Drumtassie Burn.

P. urnigerum, L. Bank of River Avon below Canal aqueduct.

P. piliferum, Schreb. Common on walls and dry stony places, specially in the upland parts of the county.

P. juniperinum, Willd. Common on waste places, and dry peaty places on the moors.

P. gracile, Dicks. Hopetoun woods; Houston Wood; Fauldhouse Moor.

P. commune, L. Very common in woods and on moors throughout the county.

Pleuridium axillare, Lindb. Ditch near Linlithgow, W. E. Drumshoreland Curling Pond, J. M'A.

P. subulatum, Rabenh. Footpath on west side of Craigiehall Wood; N.B. railway embankment near Craigie, J. M'A., l.c., p. 205.

P. alternifolium, Rabenh. N.B. railway embankment near Craigie, J. M'A., l.c., p. 205.

***Ditrichum homomallum**, Hampe. Bank of River Avon below Canal aqueduct. [*Didymodon heteromallum* recorded from parish of Bo'ness in New Stat. Acc, ii, p. 127, probably refers to this species.]

[*Didymodon capillaceum*. Parish of Abercorn, New Stat. Acc., ii, p. 22.] If this is *D. capillaceum*, Schrad. = *Swartzia montana*, Lindb., it is unlikely to have occurred in this district.

***Seligeria recurvata**, B. & S. Near Ecclesmachan.

Ceratodon purpureus, Brid. Very common.

Rhabdoweisia denticulata, B. & S. Summit of Cocklerue, J. M'A.

Cynodontium Bruntoni, B. & S. Binny Crag, W. E. Cocklerue, J. M'A., l.c., p. 205, seems to be an error, and probably refers to Mr. Evans' record.

Dichodontium pellucidum, Schp. Breich Water; River Almond; River Avon.

Dicranella heteromalla, Schp. Common on shady banks, in woods, etc.

D. cerviculata, Schp. Drumshoreland Moor, J. M'A.; near Winchburgh, W. E.; near Fauldhouse; Humbie Quarry, Kirkliston.

D. varia, Schp. Drumshoreland, W. E. Almondell.

D. squarrosa, Schp. Near Cocklerue, W. E.

Dicranoweisia cirrata, Lindb. Binny Crag, Grev. Flora Edin., p. 237 (sub *Weissia*). Common on trunks of trees, rocks, etc., in all parts of the county.

Campylopus flexuosus, Brid. Blawhorn Moss.

C. pyriformis, Brid. Balvormie; Houston Wood; and other peaty woods and moors. [*Dicranum flexuosum* described as covering entire bank at Tod's Mill, in abundant fructification, parish of Bo'ness, New Stat. Acc., ii, p. 125, may refer to this species.]

C. fragilis, B. & S. Avon valley, W. E.

Dicranum Bonjeani, De Not. Stream near Binny Crag, W. E.; Galabraes, Bathgate Hills.

D. scoparium, Hedw. Woods, moors, rocky places, and sometimes tree trunks throughout the county.

D. majus, Turn. Bowdenhill.

Leucobryum glaucum, Schp. Blawhorn, W. E.; Bee Crags · Houston Wood.

***Fissidens exilis**, Hedw. Clay bank, Winchburgh, W. Edgar Evans.

F. pusillus, Wils. Linlithgow, W. Bell. (Herb. Edin.); Dalmeny Park, W. E.; Midhope Glen, S. E. B.

F. incurvus, Starke. Near Port Edgar, J. M'A., l.c., p. 205.

F. bryoides, Hedw. Frequent on damp shady banks, Avon and Almond ravines, Midhope Glen, etc.

F. adiantoides, Hedw. Old quarry, Galabraes, Bathgate.

F. taxifolius, Hedw. Bridge Castle, W. E Midhope Glen.

Grimmia apocarpa, Hedw. Common on walls in the upland region. Frequent elsewhere.

var. **rivularis**, W & M. River Avon; Ecclesmachan Burn.

G. maritima, Turn. Shore east of South Queensferry, W. E.; shore near Society.

G. pulvinata, Smith. Common on walls both in the upland and lowland parts of the county.

G. trichophylla, Grev. Parish of Bo'ness, New Stat. Acc, ii, p. 127; Craigiehall Wood, J. M'A.; near Carlowrie, W. E.; Craigs Quarry, Kirkliston

***G. leucophaea**, Grev. Parish of Abercorn, New Stat. Acc., ii, p. 22

Rhacomitrium aciculare, Brid. Common on rocks in most of the streams

R. fasciculare, Brid. Common on rocks and walls.

R. heterostichum, Brid. Western heights of Ecclesmachan parish, New Stat. Acc., ii, p. 110 (sub *Trichostomo*) Common on rocks and walls, especially in the upland region.

R. lanuginosum, Brid Bowdenhill.

R. canescens. Brid. Western heights of Ecclesmachan parish, New Stat. Acc., ii, p. 110 (sub *Trichostomo*). Near North Mains.

var. **ericoides**, B. & S. Census Cat.

Ptychomitrium polyphyllum, Furn. Wall near Craigton; stones by roadside south of Linlithgow; old quarry, Philpstoun.

Hedwigia ciliata, Ehrh. Craigiehall Wood, J. M'A.

Phascum cuspidatum, Schreb. Census Cat.

***P. cuspidatum**, Schreb., var. **piliferum**, Hook. & Tayl. South Queensferry, W. E.

Pottia Heimii, Furnr. Parish of Bo'ness, New Stat. Acc., ii, p. 127 (sub *Gymnostomo*). East side of Forth Bridge, W. Edgar Evans. Mouth of Longreen Burn, Dalmeny shore, J. M'A.

P. truncatula, Lindb. Field near South Queensferry, W. E. Near Kirkliston.

***P. minutula**, Furnr. Drumshoreland, W. E.

P. lanceolata, C. M Wall near Kirkliston, Grev. Flora Edin., p. 236 (sub *Weisma*). Old bing, Craigton.

***Tortula rigida**, Schrad. Grows abundantly by riverside at Inneravon, New Stat. Acc., ii, p. 124

T. ambigua, Angstr. Bank of River Almond near Illieston.

T. muralis, Hedw. Very common on walls throughout the county.

T. subulata, Hedw. Ecclesmachan, Craigton, and elsewhere frequent.

***T. intermedia**, Berk. Wall by towpath of Union Canal near Auldcathie; old bing, Craigton.

T. ruraliformis, Dixon. Hopetoun shore, S. E. B. Shore at Dalmeny Park, W. E.

Barbula lurida, Lindb. Railway cutting, Port Edgar, J. M'A., l.c., p. 205.

B. rubella, Mitt. Common on damp walls, stony places, etc.

B. tophacea, Mitt. Parish of Bo'ness, New Stat. Acc., ii, p. 127 (sub *Didymodon trifario*). Rocks by the Almond below Cramond Brig, W. E. Bank of River Almond near Illieston; railway cutting, Winchburgh; railway cutting, Port Edgar.

B. fallax, Hedw. Bank of River Almond near Illieston.

B. spadicea, Mitt. Stones in River Almond near Cramond, W. E.

B. rigidula, Mitt. Drumshoreland, W. E.

B. cylindrica, Schp. Wall at Carlowrie; W. E.; wall by towpath of Union Canal, Auldcathie; boundary wall of Newliston Park.

B. vinealis, Brid. Wall near Livingstone.

B. Hornschuchiana, Schultz. West of South Queensferry, J. M'A., l.c., p. 205.

B. revoluta, Brid. Old stone walls about Kinneil, New Stat. Acc., ii, p. 125 (sub *Tortula*). Common on mortar of dry walls.

B. convoluta, Hedw. Old road near Bellside, and elsewhere frequent.

B. unguiculata, Hedw. Common on walls, waste ground, etc.

Leptodontium flexifolium, Hampe. Binny Crag; about Craigiehall Dykes, J. M'A.; Dechmont Law.

Weisia viridula, Hedw. Earthy rocks, River Almond, at Illieston; and elsewhere frequent.

*var. **densifolia**, B. & S. Carribber Glen, W. E.

***W. mucronata**, B. & S. Drumshoreland, W. E.

W. rupestris, C. M. Mouth of railway tunnel, Port Edgar, J. M'A.

W curvirostris, C. M. Ecclesmachan, Grev. Fl. Edin., p. 227 (sub *Gymnostomo*). Very abundant and luxuriant in the railway cutting near Winchburgh.

W. verticillata, Brid. Census Cat

Trichostomum flavovirens, Bruch. About Society and elsewhere on shore near South Queensferry, J M'A. and W. E.

Cinclidotus fontinaloides, P. Beauv. River Almond at Craigiehall, J. M'A.; Ecclesmachan burn; River Avon.

Encalypta vulgaris, Hedw. Blackness, W. E.

E. streptocarpa, Hedw. Abundant on walls near Torphichen and Linlithgow.

Zygodon Mougeotii, B. & S. Rocks in Carribber Glen.

Z. viridissimus, R Brown. Near Linlithgow, W. Bell (Herb., Edin.).
var. **rupestris**, Hartm. Wall west of South Queensferry.

Z Stirtoni, Schp. Near South Queensferry, W. E.

***Ulota Bruchii**, Hornsch. Carribber Glen, W. E.

U. phyllantha, Brid. Shore at South Queensferry.

***Orthotrichum anomalum**, Hedw., var. **saxatile**, Milde. Wall by towpath of Union Canal near Craigton; stones in old quarry, Philpstoun; loose rocks, Bathgate Hills.

***O cupulatum**, Hoffm, var. **nudum**, Braithw. River Almond at Craigiehall, J. M'A. Rocks in River Avon below Canal aqueduct.

O. affine, Schrad Dalmeny Park, W. E.

O. rivulare, Turn. Linlithgow, W. Bell, anno 1869 (Herb., Edin.) Still in this locality on the River Avon in June 1916.

O pulchellum, Smith. South Queensferry; Drumshoreland Moor, Grev. Fl. Edin., p. 249.

O. diaphanum, Schrad. Parish of Bo'ness, New Stat. Acc., ii, p. 125.

***Splachnum sphaericum**, Linn. fil Blawhorn Moss, W. E., 1916.

Ephemerum serratum, Hampe. Field at Drumshoreland, W. E.

Physcomitrella patens, B. & S. West of South Queensferry, J. M'A., l.c., p. 205.

Physcomitrium pyriforme, Brid. Near Linlithgow, J. M'A.

Funaria Templetoni, Sm. A barren specimen growing on a rock in the River Avon was doubtfully referred to this species by R. H. Meldrum.

F. hygrometrica, Sibth. Very common throughout the county.

Aulacomnium palustre, Schwaeg. Drumshoreland and Fauldhouse, W. E. Blawhorn Moss; Houston Wood.

*__A. androgynum__, Schwaeg. On sunk wall and fallen timber, Newliston; wall near Kirkliston Distillery.

Bartramia ithyphylla, Brid. Kirkliston Distillery, J. M'A., l.c., p. 205.

B. pomiformis, Hedw. Crevices of rocks, banks, and walls both in the upland and lowland regions; frequent.

var. **crispa**, B. & S. Carribber Glen, W. E.

Philonotis fontana, Brid. Common along the streams and ditches of the upland country.

P. calcarea, Schp. Beside Canal, near Linlithgow, J. M'A.

*__Breutelia arcuata__, Schp. Drumshoreland Moor, W. E.

Leptobryum pyriforme, Wils Kirkliston Distillery, J. M'A., l.c., p. 205.

Webera cruda, Schwaeg. Wall near Cramond Bridge, J. M'A. Rocks by stream, S.W. of Binny Crag, W. E. Rocks, Carribber Glen; rocks by roadside south of Linlithgow.

W. nutans, Hedw. Abundant on banks, earthy rocks and walls, and decaying timber in the lowlands; and on the moors in the uplands.

W. annotina, Schwaeg. Drumshoreland, J. M'A., l.c., p. 205. Fields near Balvormie

W. proligera, Bryhn. Binny Crag, W. E

*__W. carnea__, Schp. Bank of River Almond, near Livingstone, W. E. Bank of River Almond, Illieston; bank of River Avon below Canal aqueduct.

W. albicans, Schp. Railway cutting, Winchburgh; banks of the Avon and the Almond; and elsewhere by damp roadsides, etc., frequent.

Bryum pendulum, Schp. Wall, Hawes Brae, J. M'A

B. pallens, Sw. Bank of River Avon.

B. pseudo-triquetrum, Schwaeg. Railway cutting, Winchburgh.

B. bimum, Schreb. Drumshoreland, W. E.

B. caespiticium, L. Common on mortared walls.

B. capillare, L. Very common on damp walls.

B. atropurpureum, W. & M Walls near South Queensferry, Greville, (Herb. Edin.).

B. alpinum, Huds. Cocklerue, J. M'A., l.c., p. 205.

B. argenteum, L. Common on waste ground, footpaths, etc.

B. roseum, Schreb. East of Longreen, Dalmeny, J. M'A. Near Blackness Castle, W. Edgar Evans.

Mnium affine, Bland. Near Torphichen and Carlowrie, W. E. Carribber Glen.

M. cuspidatum, Hedw. Humbie Quarry, near Winchburgh, W. E.

M. rostratum, Schrad. Parish of Bo'ness, New Stat. Acc., ii, p. 127 (sub *Bryo*). Ditch, Swineburn, Kirkliston, S. E. B. Carlowrie, W. E. Carribber Glen, W. Edgar Evans.

M. undulatum, L. Parishes of Abercorn and Bo'ness, New Stat. Acc., ii, p. 22 and p. 127 (sub *Bryo ligulato*). Common in damp woods, especially in the river ravines.

M. hornum, L. Very common in woods and shady places.

M. serratum, Schrad. Bank of River Almond above Cramond Bridge, J. M'A. Carribber Glen, W. E.

M. stellare, Reich North of Linlithgow; Carribber Glen (the locality on which the Census Cat. record was based, W. E).

M. punctatum, L. Parish of Abercorn, New Stat. Acc., ii, p. 22 (sub *Bryo*). Common on damp banks and rocks by streams, also in marshes and bogs in the moorland region

M. subglobosum, B & S. Census Cat.

Fontinalis antipyretica, L. River Avon; Ecclesmachan Burn; pond near Port Edgar.

Neckera complanata, Hubn. Parish of Bo'ness, New Stat. Acc., ii, p. 127 (sub *Hypno*). Avon valley near Woodcockdale.

Homalia trichomanoides, B & S. Below Cramond Bridge, J. M'A. Avon valley near Woodcockdale; Almond valley near Illieston.

Pterygophyllum lucens, Brid. Parish of Bo'ness, New Stat Acc., ii, p. 127 (sub *Hookeria*). Carribber Glen, W. E.

Porotrichum alopecurum, Mitt. Parish of Bo'ness, New Stat. Acc., ii, p. 127 (sub *Hypno*). Inchgarvie, South Queensferry. S. E. B. Carribber Glen; River Almond near Illieston

Leskea polycarpa, Ehrh. River Almond below Cramond Bridge, J. M'A.

Heterocladium heteropterum, B. & S. Census Cat.

Thuidium tamariscinum, B. & S. Common in open deciduous woods, etc.

T. recognitum, Lindb. West of South Queensferry, J. M'A., l.c., p. 205.

Climacium dendroides, Web. & Mohr. Old bing, Craigton; and frequent in marshy places in the uplands.

Camptothecium sericeum, Kindb. Common on walls both in the upland and lowland districts.

C. lutescens, B. & S. Census Cat.

Brachythecium albicans, B. & S. Hopetoun shore, S. E. B. Dalmeny shore, J. M'A. Binny Crag, W. E.

B. rutabulum, B. & S. Common on damp ground, shady walls, etc.

B. rivulare, B. & S. Rocks by River Avon and River Almond.

B. velutinum, B. & S. Craigiehall Wood, J. M'A. Damp wall near Philpstoun and similar situations frequent.

B. populeum, B. & S. Carribber Glen, W. E. Almond valley near Illieston.

B. plumosum, B. & S. Carribber Glen.

B. purum, Dixon. Common on damp grassy banks and fields.

Eurhynchium piliferum, B & S. Hopetoun woods, New Stat. Acc., ii, p. 125 (sub *Hypno*). Almondell; Carribber Glen; Kirkliston Distillery.

E. crassinervium, B. & S. Almond valley below Cramond Bridge and below Craigiehall Bridge, J M'A.

E. praelongum, Hobk. Very common in the lowland woods, etc.

E. Swartzii, Hobk. Near Philpstoun.

E. myosuroides, Schp. Carribber Glen; Almondell; Canal embankment, Winchburgh

E. myurum, Dixon. Almondell; near Linlithgow

E. striatum, B. & S. Almondell; Avon valley.

E. rusciforme, Milde. Common in most of the streams which do not suffer from excessive pollution.

E. murale, Milde. Old stone walls about Kinneil, New Stat. Acc., ii, p. 125 (sub *Hypno*). On Dalmeny shore, west of River Almond, J. M'A. Old wall in wood by River Avon, Woodcockdale

E. confertum, Milde. Damp wall by Union Canal, Philpstoun, and similar situations frequent.

Plagiothecium depressum, Dixon. Side of River Almond below Craigiehall Bridge, J. M'A.

P. elegans, Sull. Craigiehall Wood; Almond valley south of Cramond Bridge, J. M'A. Bridge Castle, W. E.

P. denticulatum, B. & S. Cocklerue, J. M'A. Common on banks and rocks in shady places.

P. sylvaticum, B. & S. Craigiehall Wood, J. M'A.; near Binny Crag, W. E.

P. undulatum, B. & S. Common in woods, on heaths, etc., throughout the county.

Amblystegium serpens, B. & S. Common on damp walls, stones, and old tree stumps

A. filicinum, De Not. Near Linlithgow, W. Bell (Herb., Edin.). West of South Queensferry, J. M'A. Railway cutting, Winchburgh; frequent in the river ravines.

Hypnum riparium, L. Linlithgow Loch, J. M'A., l.c., p. 205. West of South Queensferry, J. M'A. Humbie Reservoir, W. E.

H. stellatum, Schreb. Census Cat.

var. **protensum**, Rohl. Drumshoreland Curling Pond, J. M'A., l.c., p. 205. Wall south of Linlithgow; old limestone workings north of Bathgate.

H. aduncum, Hedw. non L. Census Cat. (may be based on record by Bell and Sadler in Trans. Bot. Soc. Edin., 1869; see *H. falcatum*).

H. fluitans, L. Fauldhouse Moor, W. E.

*var. **falcatum**, Schp. Houston Wood.

H. exannulatum, Gumb. Drumshoreland Curling Pond, J. M'A., l.c, p 205.

*var. **pinnatum**, Boul., f. **acuta**, Sno. Houston Wood. f. **montana**, Ren. Drumshoreland, J. M'A. (Herb., Wheldon). f. **gracilis**, Ren Drumshoreland Curling Pond, J. M'A. (Herb., Wheldon).

H. uncinatum, Hedw. Common on moist banks and rocks, especially in the Almond and Avon ravines.

H. commutatum, Hedw. Railway cutting, Winchburgh.

***H. falcatum**, Brid. Linlithgow, W. Bell (Herb. Edin.)—named *H. aduncum* in Bell's handwriting, and evidently the plant upon which record by Bell and Sadler in Trans. Bot. Soc. Edin. was based.

H. cupressiforme, L. Very common on walls, fallen timber, etc.

var. **resupinatum**, Schp. Dalmeny Park, W. E.

var. **filiforme**, Brid. Trees in the Avon ravine.

var. **ericetorum**, B. & S. Blawhorn Moss, W. E. Houston Wood; Drumshoreland Moor.

H. Patientiae, Lindb. South of Linlithgow, J. M'A. Near Bathgate, W. E Roadside near North Mains.

H. molluscum, Hedw. Almondell; Carribber Glen; Bathgate Hills.

H. palustre, Huds. River Almond at Cramond, J. M'A. Rocks by the River Avon, and by most of the rocky streams in the county.

***H. eugyrium**, Schp., var. **Mackayi**, Schp. Riccarton, W. E.

H. ochraceum, Turn. Census Cat.

***H. stramineum**, Dicks. Blawhorn, W. E. Fauldhouse; Houston Wood.

H. cordifolium, Hedw. Drumshoreland Curling Pond, J. M'A, l.c., p. 205. Pond near Philpstoun House.

H. cuspidatum, L. Very common in marshes and wet places by ponds and streams.

H. Schreberi, Willd. Common in heathy woods like Drumshoreland and Houston, and on the upland pastures.

Hylocomium splendens, B. & S. Bank of River Avon near Canal aqueduct; frequent in the uplands.

H. loreum, B & S. Cocklerue and Drumshoreland, W. E. Bowdenhill.

H. squarrosum, B. & S. Common in woods, grassy banks, damp pastures.

H. triquetrum, B. & S. Dalmeny Park and Drumshoreland, W. E., Bellside woods

CERATOPHYLLUM DEMERSUM, LINN. IN THE ORKNEY ISLES. BY ARTHUR BENNETT, A.L.S.

(Read 8th February 1917.)

Mr. Magnus Spence (author of the Flora Orcadensis) has sent me living specimens of the above from Graemshall Loch, in the south of the Mainland. I know of no certain record north of Forfar, where it is plentiful in the Lochs of Rescobie and Balgavies.

But there is no climatal or distributional reason against its occurrence to the extreme north of Scotland, as it occurs in Sweden to W. Norrland in 65° N. lat., in Norway at Ullenensaker in 60° 5′ N. lat., and in Finland in 63° N. lat.

Mr. Spence's specimens are also of interest, as they are provided with winter-buds, or gemmae. I have looked through many British and European Floras but can find no mention of such. So I sent specimens to Mr. W. Worsdell, F.L.S., and he kindly replied: "Many thanks for sending me the winter-buds of *Ceratophyllum*. They seem to be known, however. I have to-day found a reference to them in Schenk's Biologie des Wassergewächse as follows: 'Irmisch found in many cases that the leaves of the branch-tips became curved over one another and the older internodes died off, so that the terminal buds represented small, loosely-compacted, isolated clumps, which grow out in spring.'"

These winter-buds seem to be very like those of *Utri-*

cularia, having the same dense texture, with stiff hairs in abundance.

Mr. R. Heddle reported *Ceratophyllum* from "Loch of Ayre, Kirbister." But Col. H. H. Johnston has a specimen from Heddle, and it proves to be *Utricularia vulgaris*, Linn., which Miss Boswell reported for Orkney in Watson's Top. Botany, i, p. 319 (1874).

Ulex nanus, Forster in Caithness. By Arthur Bennett, A.L.S.

(Read 8th February 1917.)

Lately (14th October 1916) Mr. G. Lillie of Lybster sent me specimens of *Ulex nanus* from Ben Alisky, a hill in the parish of Halkirk, about 12 miles north of Berriedale. The hill is 1142 feet high, and the *U. nanus* occurred at about 800 feet. The specimens are very dwarf, the young stems very hairy with white shaggy hairs. Beneath the primary spines are here and there unifoliate leaves, exactly the same as I possess in seedlings of *U. europaeus*; these are above the trifoliate leaves (which succeed the cotyledonary ones), and number nine before the spines commence.

There are no roads near this hill; "the nearest house is Dallawillan Lodge, about a mile from it."

Mr. G. Lillie writes that his niece and nephew (Miss A. Lillie and Mr. W. Lillie of Watten Manse) found the plant on an excursion to Morven, and "although the general effect of the hill is rather barren, it had, among other plants, *Vaccinium Vitis-Idaea*, *Arctostaphylos Uva-ursi*, *Listera cordata*, *Lycopodium alpinum*, and *Solidago Virga-aurea*."

This locality is the most northern in Europe, being about 58° 20′ N. lat. I know of no station in Europe north of 50° N. lat.

The only Scottish stations I have seen specimens from are Kirkcudbright (Professor Oliver) and Dumfries (Mr. Fingland).

Note on Insect Visitors to Corallorhiza innata and some other Orchids in the Forth District. By William Evans, F.R.S.E.

(Read 12th April 1917.)

In Knuth's Handbook of Flower Pollination (Engl. ed. iii, p. 347, 1909) no "visitor" is given in the case of *Corallorhiza innata*, R. Br.; but, from the small size of the flowers, it is concluded "that they are visited by small insects, which use the anterior downwardly bent part of the labellum as an alighting-platform, and creep thence to the nectar secreted and concealed at the steeply downwardly bent base of the organ." As proof of the correctness of the first part of this conclusion, the following incident seems worth putting on record.

On June 5, 1908, I found a group of half a dozen spikes of the coral-root orchid (*Corallorhiza innata*) in a stretch of rather boggy ground beside Loch Leven, Kinross-shire The flowers were at their best, and had proved attractive to a species of small black fly, numbers of which were settled on each of the spikes. When disturbed they were in no haste to leave the flowers (perhaps the nectar had made them drowsy), creeping away among the grass rather than attempting to escape by flight, so that their capture was an easy matter. A score might have been secured without any difficulty; but, as it was, two for identification were all that I took. An attempt, with Mr. P. H. Grimshaw's help, to identify them at the Royal Scottish Museum having failed, I submitted the specimens to Mr. Austen, of the British Museum, who found them to agree with an *Empis* from Nairn which he had labelled ? sp. nov. Here the matter rested till last year, when Mr. J. E. Collin saw my two specimens and identified them as a species standing in the late Mr. Verrall's collection under the MS. name of *Empis snowdoniana*. Though no description of it has, so far as I am aware, yet been published, the species, with Verrall's MS. name for it, has been recorded from Sutherland by Colonel Yerbury in the Scottish Naturalist for December 1912.

My Loch Leven specimens are both males, as were also, I believe, all the others at the coral-root flowers, on the nectar of which they were doubtless feeding. Unfortunately I did not think of observing how they reached the hidden nectar, but one might conjecture that the long proboscis—a characteristic of the genus *Empis*—would be useful in this connection. Empids, of both sexes, besides sucking nectar, prey also on small insects, chiefly Diptera. In the use of this insect prey, a very remarkable habit in relation to courtship has been investigated by Mr. A. H. Hamm (see report by Professor Poulton, in Ent. Mo. Mag., 1913, p. 177). In some species the male, as they play in the air, presents the female with a fly which she carries about and sucks during pairing. In others the gift takes the form of a coccoon which he has spun about the fly. Or the plaything may consist of some such object as the stamen of a buttercup.

Empis snowdoniana is a small, blackish, somewhat shining fly, with pale smoky-brown wings. Length (head and body) about 5 mm.; expanse of wings about 9 mm. It is probably not uncommon in early summer on meadows and moors in the Edinburgh district. Besides the Loch Leven examples, I have a female taken above Silverburn, on the south side of the Pentland Hills, May 27, 1895, and a male from Bavelaw Moss, to the north of the same range, May 20, 1904

In the case of *Goodyera repens*, R. Br., Knuth states that only humble bees (e.g. *Bombus pratorum*, L., in North Scotland, and *B. mastrucatus*, Gerst., in the Alps) had so far been observed as visitors to its flowers; but that Muller "is inclined to think, however, that the true pollinators are small, short-tongued insects, to which the structure of the flower is adapted." On August 7, 1909, happening to pass through a pine wood in East Lothian where this interesting orchid grows, I noted the following insect-visitors to the flowers:—viz. *Bombus pratorum*, L., a good many; *B. lucorum*, L., many; and two hover-flies, *Syrphus cinctus*, Zett., and *Platychirus albimanus*, F., one of each. The visitors thus comprise Diptera as well as bees.

Adjoining the same pine wood, some plants of *Listera ovata*, R. Br., were in fine flower, and furnished the following

fairly long list of visitors:—HYMENOPTERA: small ichneumon-fly, two. DIPTERA: *Rhamphomyia nigripennis*, F. (a small Empid), one; *Syrphus cinctellus*, Zett., one; *S. vitripennis*, Mg., two; *Hydrotaea irritans*, Fln., two; *Pteropaectria frondescentiae*, L., two. COLEOPTERA: *Meligethes aeneus*, F., one; *Malthodes minimus*, L., one; *Anaspis rufilabris*, Gyll., a great many. HEMIPTERA: *Pithanus maerkeli*, H.-S., one; *Lygus leucorum*, Mey., one. PSEUDO-NEUROPTERA: *Mesopsocus unipunctatus*, Mull. On one of the spikes were three young snails, apparently *Helix arbustorum*.

None of the above appears among the visitors to *L. ovata* mentioned by Knuth.

On a flowering spike of *Orchis maculata*, L., growing along with the *L. ovata*, the small brownish beetle, *Anaspis rufilabris*, so abundant on the latter plant, was also present in considerable numbers.

SOME MOSS RECORDS FOR SELKIRK, PEEBLES, AND THE LOTHIANS. By WILLIAM EVANS, F.R.S.E.

(Read 8th February 1917.)

The discovery of mislaid specimens and notes, and the results of some further field-work, since the publication of the Census Catalogue of British Mosses in 1907, have enabled me to supply records filling up many of the gaps in respect of the above counties. A number of these records were included by Mr. James M'Andrew in his Notes on Some Mosses from the Three Lothians (Scot. Bot. Rev., 1912, p. 202), while all the Linlithgowshire (West Lothian) ones have been given to Mr J. C. Adam for inclusion in his paper on the Mosses of that county (*antea*, p. 123). The additions contained in the present paper, therefore, relate to a large extent to the Selkirk and Peebles lists, the former of which must still be far from complete—in the Catalogue it is credited with barely sixty species. In December 1901, the late James Murray, author of the list of Mosses in the Handbook of the Fauna and Flora of "Clyde," sent me a list of 104 species he had collected in

the Broughton district of Peeblesshire. All, with three exceptions as mentioned below, are, however, given for the county in the Census Catalogue.

From the point of view of the local bryologist the Census Catalogue leaves much to be desired; it supplies him simply with a list of the species the compilers had records of from any particular county, no localities or other data being given, though to some extent these may, no doubt, be traced in the literature cited. To a great extent, however, the Catalogue is based on unpublished information. In these circumstances I have thought it desirable to include in this paper the more interesting of the records supplied by myself to the compilers.

It only remains to add that practically all my records have been at one time or another authenticated by the submission of specimens either to Mr. H. N. Dixon or Mr. R. H. Meldrum.

The nomenclature is uniform with that of the Census Catalogue.

Co. 79, Selkirk.

The additions to the list for this county, which was largely supplied by me, are as under:—The date of the Selkirk and Bowhill records is August 1903, and that of the Galashiels ones November 1910.

Polytrichum piliferum Schreb. Turf-capped walls, Selkirk.

P. juniperinum Willd. Stream-side south of Yarrow.

P. gracile Dicks Near Galashiels.

P. commune L. Tushielaw (Ettrick), and south of Yarrow.

Ceratodon purpureus Brid. South of Yarrow; Galashiels.

Dicranella heteromalla Schp. Selkirk; Yarrow; Galashiels.

D. squarrosa Schp. East of Newhall Water between Yarrow and Traquair, May 1917.

Dicranum majus Turn. Banks of Yarrow at Bowhill.

Leucobryum glaucum Schp. Near Tushielaw, Aug. 1903.

Fissidens bryoides Hedw. East of Newhall Water.

Grimmia apocarpa Hedw., var. **rivularis**, W. & M. Newhall Water

G. pulvinata Smith. Selkirk; Galashiels, etc.

Rhacomitrium fasciculare Brid. Wall near Galashiels.

R. heterostichum Brid. Selkirk; Galashiels, etc.

R. lanuginosum Brid. Hills near Tushielaw, and south of Yarrow.

R. canescens Brid. Selkirk; east side of Newhall Water.

Hedwigia ciliata Ehrh. Near Galashiels.

Pottia truncatula Lindb. Field at Selkirk.

Tortula muralis Hedw. Walls about Selkirk and Galashiels

T. subulata Hedw. Selkirk; Bowhill.

T. ruralis Ehrh. On wall east of Newhall Water, May 1917

Barbula rubella Mitt. Selkirk; Bowhill; Galashiels.

B. cylindrica Schp. Bowhill.

B. unguiculata Hedw. Selkirk; Galashiels.

Ulota Bruchii Hornsch. On birches east of Newhall Water.

Orthotrichum Lyellii H. & T. On trees at Selkirk and Bowhill.

O affine Schrad. Near Galashiels; on wall east of Newhall Water.

O. diaphanum Schrad. Wall near Galashiels.

Aulacomnium palustre Schwaeg. East of Newhall Water

Bartramia ithyphylla Brid. Banks of Yarrow at Bowhill

B. pomiformis Hedw. Near Galashiels

Webera nutans Hedw. Galashiels; south of Yarrow.

W. albicans Schp. Selkirk; east of Newhall Water, May 1917

Bryum pallens Sw. East of Newhall Water.

B. pseudo-triquetrum, Schwaeg. East side of Newhall Water, Selkirk

B. caespiticium L. Selkirk; Galashiels.

Mnium affine Bland. Roadside south of Galashiels.

M. undulatum L. East of Newhall Water.

Fontinalis antipyretica L. In stream south of Yarrow.

Neckera complanata Hubn. Bowhill

Leucodon sciuroides Schwaeg. Selkirk; Bowhill.

Porotrichum alopecurum Mitt. Rocks by the Yarrow at Bowhill

Climacium dendroides W. & M. Selkirk; Tushielaw; Yarrow.

Brachythecium rivulare B. & S. Bowhill.

B. velutinum B. & S. Selkirk; Galashiels.

B. populeum B. & S. Near Galashiels.

Eurhynchium myosuroides Schp. Selkirk; east of Newhall Water.

E. striatum B. & S. Bowhill.

E. rusciforme Milde. Burns near Selkirk and Yarrow

Plagiothecium denticulatum B. & S., var. **majus**, Boul. Bowhill (specimen determined by Mr. Meldrum).

P. silvaticum B. & S. East of Newhall Water.

Amblystegium serpens B. & S. Bowhill; Galashiels

Hypnum commutatum Hedw. and **H. palustre** Huds. Selkirk; south of Yarrow.

Co. 78, Peebles.

(*a*) Additions to the Census Cat. list:—

Sphagnum cymbifolium Ehrh., var. **congestum** Schp. Moss south of Leadburn, Sept. 1904.

S medium Limpr. Moss south of Leadburn, Sept. 1904

S Austini Sull Moss south of Leadburn, Sept 1904.
These three Sphagna were determined for me by Mr Dixon

Tetraphis pellucida Hedw. Macbiehill; Whim, 1916 (J. C. Adam).

Polytrichum alpinum L Hills between Eddleston and Moorfoot Water, March 1904.

P. formosum Hedw. Darnhall, Eddleston, Nov. 1916.

Pleuridium axillare Lindb. Portmore Loch, Oct. 1905

Dicranella rufescens Schp. Portmore Loch, very abundant and fine, Oct. 1914. **D. varia** Schp Medwyn Water, Aug. 1904.

Campylopus pyriformis Brid. This and *C. flexuosus* Brid. on moor south of Leadburn, May 1902.

Dicranum Bonjeani De Not. Between Dolphinton Station and West Linton, Aug. 1903; Darnhall.

D. majus Turn. Macbiehill; Cowie's Linn, near Eddleston, April 1902.

Leucobryum glaucum Schp. Moor between Redfordhill and Cowie's Linn, April 1902; etc

Grimmia trichophylla Grev. Whitfield, near Macbiehill, Feb. 1896.

Phascum cuspidatum Schreb. Fields at Macbiehill.

Tortula ruralis Ehrh. Old wall near Eddleston, Sept. 1904; Traquair, May 1917; near Broughton (J. Murray).

Barbula fallax Hedw. Near Cowie's Linn; Fairliehope, Carlops.

B. spadicea Mitt. Medwyn Water, Aug. 1904.

B. vinealis Brid. Wall west of Carlops, May 1902; Eddleston.

Orthotrichum anomalum Hedw., near var. *saxatile* Milde, "but not quite" (Dixon). On wall west of Carlops, May 1902.

O. diaphanum Schrad. Near Broughton (J. Murray); Darnhall.

Splachnum sphaericum Linn. fil. Millstone-rig, Pentlands, Aug., and moss south of Leadburn, Sept. 1904.

Tetraplodon mnioides B. & S. Near source of the Medwyn, Peeblesshire side of co. boundary, July 1872. See Trans. Bot. Soc., xi, 456.

Funaria hygrometrica Sibth. Macbiehill; Cowie's Linn; etc.

Philonotis calcarea Schp. Near West Linton, Aug. 1903.

Bryum argenteum L. Eddleston; Innerleithen, comn. May 1917.

B. roseum Schreb. Grassy bank at Innerleithen, Jan. 1897.

Mnium rostratum Schrad. Cowie's Linn, April 1902.

M. serratum Schrad. Cowie's Linn, April 1902; North Esk above Carlops, May 1902.

M. stellare Reich. Near Eddleston, 1915 (J. C. Adam).

M. subglobosum B. & S. Near West Linton, Aug. 1903. Probably this species, but no capsules were seen.

Fontinalis antipyretica L., var. **gracilis** Schp. Eddleston Water above Earlyvale, Oct. 1914.

Homalia trichomanoides B. & S. Macbiehill; Cowie's Linn; Darnhall.

Pterygophyllum lucens Brid. Near Carlops, 1902.

Leucodon sciuroides Schwaeg. Portmore, May 1902; Darnhall, Nov. 1916.

Pylaisia polyantha B. & S. Macbiehill, on trees, chiefly elm, Nov. 1873 and Feb. 1874, and on gooseberry bushes in garden, March 1875, etc.; Portmore, on old hawthorn, 17th May 1902; all c. fr.

Camptothecium lutescens B. & S. Near Cowie's Linn, April 1902.

C. nitens Schp. Between Dolphinton Station and West-Linton, Aug. 1903 and June 1904.

Brachythecium albicans B. & S. Lee Pen, Innerleithen, c. fr., Jan. 1897; near Cowie's Linn, April 1902.

Eurhynchium confertum Milde. Near Eddleston, April 1902.

Plagiothecium sylvaticum B. & S. Cowie's Linn, April 1902.

Amblystegium serpens B. & S. Macbiehill; Cowie's Linn; Darnhall.

A. irriguum B. & S. Rocks on both sides of the North Esk behind Carlops, May 1902. (Determined by Dixon.)

Hypnum fluitans L. Harlaw Moor west of Auchencorth, Oct. 1906.

H. commutatum Hedw. Near Innerleithen; Cowie's Linn.

H. cupressiforme L., var. **ericetorum** B. & S. Innerleithen; Darnhall.

H. molluscum Hedw., var. **condensatum** Schp. Cowie's Linn. (Named by Dixon.)

H. palustre Huds. North Esk above Carlops; Cowie's Linn.

H. stramineum Dicks. Medwyn Water, Aug. 1904; Harlaw Moor.

H. cordifolium Hedw. Wet meadow at Netherurd, July 1910.

H. giganteum Schp. Near Broughton (J. Murray); North Esk Reservoir above Carlops, Oct. 1914. I have a note of having seen a specimen many years ago from the head of Medwyn Water.

(*b*) Localities for some of the less common species recorded for the county in the Census Cat.:–

Oligotrichum hercynicum Lam. (*incurvum* Lindb.). Pentlands beside road west of North Esk Reservoir, Aug. 1904; Darnhall, Eddleston, Nov. 1916. Barren in both instances.

Polytrichum nanum Neck. Leithen Water, near Innerleithen, Jan. 1897.

Diphyscium foliosum Mohr. Near Broughton (J. Murray).

Cynodontium Bruntoni B. & S. Cowie's Linn, April 1902.

Dicranella squarrosa Schp. Leithen Water, c. fr., Jan. 1897

Dicranodontium longirostre B. & S. Near Broughton (J. M.)

Dicranum fuscescens Turn. Lee Pen, Innerleithen, Jan. 1897.

Grimmia Doniana Sm. On rocks and "drystone" walls, Innerleithen Hills, Cowie's Linn, etc.

Rhacomitrium protensum Braun. Near Broughton (J. M.).

Tortula laevipila Schwaeg. Broughton (J. M.); Lamancha; Darnhall; Traquair.

Barbula rigidula Mitt. Near Broughton (J. M.).

Leptodontium flexifolium Hampe. South of Leadburn, April 1902; in fruit on hills between Eddleston and Moorfoot Water, March 1904.

Weisia rupestris C. M. Cowie's Linn, April 1902.

Cinclidotus fontinaloides P. Beauv. Near Broughton (J. M.).

Encalypta streptocarpa Hedw. Broughton (J. M.); wall at Carlops.

Zygodon viridissimus R. Br. Lamancha, April 1902; Darnhall. *Z Mougeotii* and *T. tortuosum*, Medwyn Water.

Orthotrichum leiocarpum B. & S. Near Broughton (J. M.).

O. Lyellii H. & T. Lamancha; Darnhall; Traquair.

O. rivulare Turn. Near Broughton (J. M.).

O stramineum Hornsch. Near Broughton (J. M.).

O. pulchellum Smith. Romanno Hill, Dec. 1872 (a fine specimen collected by my father); Portmore, May 1902.

Funaria ericetorum Dixon. On sides of surface drain on hillside, Leithen Water, Jan. 1897; near Broughton (J. M.).

Bartramia ithyphylla Brid. Cowie's Linn; Carlops.

Breutelia arcuata Schp. Cowie's Linn; Harlaw Moor.

Plagiobryum Zierii Lindb. Near Broughton (J. M.).

Bryum filiforme Dicks. Fairliehope, near Carlops, Aug. 1904.

Antitrichia curtipendula Brid. On old ash, Macbiehill, c. fr., July 1873,[1] and March 1875; Broughton (J. M.).

Heteracladium heteropterum B. & S. Cowie's Linn, 1902.

Brachythecium rivulare B. & S. Valley of Leithen Water in two places.

Eurhynchium piliferum B. & S. Broughton (J.M.); Darnhall.

Amblystegium fluviatile B. & S., and **A. filicinum** De Not. Near Broughton (J. M.). The latter also near Eddleston.

Hypnum falcatum Brid. Fairliehope, near Carlops.

H. Patientiae Lindb. Broughton (J. M.); roadside Harlaw Moor.

H. crista-castrensis L. Moor wood, Macbiehill, abundant, fruiting, Aug. 1872, May 1875, etc.

H. eugyrium Schp. Near Broughton (J. M.).

The following, and many other commoner species were collected at and near Cowie's Linn in April 1902:—*Grimmia apocarpa* var. *rivularis*.

Porotrichum alopecurum Mitt.; *Brachythecium plumosum* B. & S.; *Eurhynchium Swartzii* Hobk.; *Hypnum stellatum* Schreb.; *H. uncinatum* Hedw.; *H. ochraceum* Turn.; and *H. loreum* B. & S.

[1] This was recorded by me in Trans. Bot. Soc. Edin., xi, p. 520.

Co. 82, HADDINGTON.

(*a*) Additions to the Census list. Some of these are mentioned in Mr. M'Andrew's paper (loc. cit.), but without localities: those in which he gives the localities are not repeated here. *Rhacomitrium protensum* (Traprain Law, Sept. 1908) occurred in a single patch about a foot square. Besides the locality given by Mr. M'Andrew for *Zygodon Mougeotii*, I have found it at Hailes, East Linton. The Sphagna, with the exception of *S. squarrosum*, were named "on the two systems" by Mr. Wm. Ingham, York:—

Sphagnum papillosum Lindb. var. **confertum** Lindb. Dunbar Common, Lammermuir Hills, 10th Oct. 1908.

S. rigidum Schp., var. **compactum** Schp. (=*S. compactum* De C., var. *imbricatum* Warnst.). Dunbar Common, Lammermuirs, Oct. 1908.

S. squarrosum Pers. Lammermuirs above Deuchrie, June 1914.

S. acutifolium Ehrh., var. **subnitens** Dixon (=*S. subnitens* Russ. & Warnst. var. *virescens* Warnst.). Dunbar Common, Lammermuirs, Oct. 1908.

S. acutifolium Ehrh., var. **rubellum** Russ. (=*S. rubellum* Wils., var. *versicolor* Warnst.). Dunbar Common, Lammermuirs, Oct. 1908.

S. cuspidatum Ehrh., var. **submersum** Schp. Dunbar Common, Lammermuirs, Oct. 1908.

Andreaea petrophila Ehrh. Traprain Law, Sept. 1908.

Polytrichum urnigerum L. Near Castle Moffat, Lammermuirs, Oct. 1908.

P. formosum Hedw. Garleton Hills, Sept. 1908; Castle Moffat

Archidium alternifolium Schp. On side of ditch, Ormiston Hall, March 1902.

Pleuridium subulatum Rabenh. Near Oldhamstocks, April 1902.

Dicranella Schreberi Schp. In surface drains on the Lammermuirs above Bleghie, 28th June 1913.

D. squarrosa Schp. Lammermuirs above Deuchrie, Oct. 1908.

Campylopus flexuosus Brid. Lammermuirs above Castle Moffat, Oct. 1908.

Dicranum scoparium Hedw., var. **spadiceum** Boul. Garleton Hills, Sept. 1908.

Fissidens crassipes Wils. Wet rocks, river Tyne, East Linton, Sept. 1908. Identification confirmed by Mr. Dixon

Tortula aloides De Not. Sea-braes near Skateraw. Feb. 1913

Weisia verticillata Brid. Dunglass Dean, April 1902; coast east of Gullane, Oct. 1904.

Cinclidotus fontinaloides P. Beauv. Tyne at East Linton, Sept. 1908.

Orthotrichum pulchellum Smith. Ormiston Hall, March 1902.

Leptobryum pyriforme Wils. East Linton, in garden, May 1875; east side of Aberlady Bay, abundant, July 1898.

[**Webera annotina** Schwaeg. Mr. M'Andrew credits me with adding this species to the Haddingtonshire list, but I have no note of ever having gathered it in the county.]

W. carnea Schp.—Left bank of Tyne above Hailes Castle, in fine fructification, April 1913.

Bryum pseudo-triquetrum Schw., var. **compactum** B. & S. Specimen from Dirleton Links, Aug. 1897, was named by Mr. Dixon as this variety "probably."

Hypnum Wilsoni Schp. In old curling pond, Luffness Links, 7th Nov. 1908 (W. Edgar Evans and W. E.). Identification confirmed by Mr. Dixon.

H. fluitans L. Lammermuirs, on Dunbar Common, Oct. 1908, and above Blegbie, June 1913.

H. cupressiforme L., var. **elatum** B. & S. Dirleton sandhills, Jan. 1897.

H. Patientiae Lindb. Roadside at Boltonmoor, March 1904; near Castle Moffat, Oct. 1908.

H. stramineum Dicks. Dunbar Common, Lammermuirs, Oct. 1908

(*b*) Localities for some of the species recorded for the county in the Census Cat.:—

Polytrichum gracile Dicks. Boltonmoor, May 1910.

Ditrichum homomallum Hampe. Ormiston Hall Woods, March 1902; near Castle Moffat, Oct. 1908; Binning Wood, Tyninghame, May 1911.

Cynodontium Bruntoni B. & S. Garleton Hills, c. fr., Sept. 1908.

Dichodontium pellucidum Schp. Lammer Law, Oct. 1902; Banks of Gifford Water, Yester, Jan. 1904.

Dicranella varia Schp. Ormiston Hall Woods, March 1902.

Dicranoweisia cirrata Lindb. Garleton Hills, Sept. 1908.

Campylopus pyriformis Brid. Garleton Hills, Sept. 1908.

C. fragilis B. & S. Gifford, Oct. 1916.

Dicranum Bonjeani De Not. Dirleton Common, Aug. 1897; Garleton Hills; Lammermuirs above Yester.

D. majus Turn. Ormiston Hall, March 1902; Boltonmoor Wood, Aug. 1909.

Leucobryum glaucum Schp. Occurs not only on the Lammermuirs, where it is common, but also close to the sea in Tyninghame fir-woods (Aug. 1914).

Fissidens pusillus Wils. Dunglass Dean (west side), April 1902.

F. osmundoides Hedw. Traprain Law, c. fr., Sept 1908.

Pottia Heimii Furnr. Luffness Links, Aug. 1898.

Tortula rigida Schrad. Wall-top near Tranent, 1814 (specimen from my father's collection).

T. mutica Lindb. On old stump by the Tyne at Haddington, Oct. 1906.

T. laevipila Schwaeg. Eaglescairnie, April 1905; Yester; Ormiston; etc.

T intermedia Berk —Dirleton Links, on rock, Aug. 1898; Longniddry, Feb. 1901; wall at Amisfield, Haddington, Sept. 1908.

T ruralis Ehrh. Dirleton, Aug. 1897; Pressmennan, on roof of boat-house. The sub-species, *T. ruraliformis*, is very common on the sand-dunes between North Berwick and Longniddry.

T. papillosa Wils. Eaglescairnie, on old tree, April 1905; Spott, near Dunbar, on sandstone rock, Nov. 1913.

Barbula tophacea Mitt. Sides of ditch on Gullane Links; Dunglass Dean.

B. cylindrica Schp. Humbie Water, May 1903; Saltoun, Dec. 1906. *B. fallax* also at Saltoun, etc.

B. vinealis Brid. On wall at Prestonpans, June 1916.

B. convoluta Hedw. Old road, Boltonmoor, March 1904; Gullane Hill, Dec. 1906.

Weisia curvirostris C. M. Near the waterfall at Billsdean, E. Lothian (J. Hardy, Moss Fl. East. Borders, 1868). This is the Census Cat. record.

Encalypta vulgaris Hedw. Prestonpans; old quarry near Gullane, 1916 (J. C. Adam).

E. streptocarpa Hedw. Near Saltoun Hall, on old wall, abundant, Dec. 1906.

Zygodon viridissimus R. Br. Yester, Jan. 1902; Eaglescairnie; Luffness.

Ulota crispa Brid. Boltonmoor Wood, c. fr., on oak, March 1904. *U. Bruchii* I have also gathered in this locality, and in a good many others in the county.

U. phyllantha Brid. Boltonmoor Wood, on oaks, March 1904.

Orthotrichum rupestre Schleich. North Berwick Law, Aug. 1897; Hailes, near East Linton, Sept. 1908.

O. leiocarpum B. & S. Saltoun, May 1904. The 82 records for this species and *O. cupulatum* are based, I understand, on specimens from Dirleton, in the Herbarium, Royal Botanic Garden, Edinburgh.

O. Lyellii H. & T. Yester; Eaglescairnie; West Saltoun.

O. diaphanum Schrad. On ash, West Saltoun, Dec. 1906; on wall, Luffness; on elder, Seacliff and Port Seton.

Physcomitrium pyriforme Brid. Gosford, May 1890; left bank of Tyne above Hailes Castle, April 1913.

Amblyodon dealbatus P. Beauv. Luffness and Gullane Links on many occasions; particularly plentiful in June 1909. *Meesia tricholdes* is now very rare in this station; I last saw it there in May 1909

Aulacomnium palustre Schwaeg. Luffness Marsh; Dunbar Common, Lammermuirs.

Catoscopium nigritum Brid. Gullane Links, large fruiting patches in July 1897 and June 1909; the best spots for it have, however, now been destroyed by the extension of the golf course on the hill. Gullane Links has long been known as a locality for this interesting plant; I find it noted by my father in 1846, and it is mentioned in Stark's little book on British Mosses

Philonotis calcarea Schp. Luffness Marsh, male "flowers" abundant, but only a few capsules, July 1898.

Webera cruda Schwaeg. Garleton Hills and Traprain Law.

W. albicans Schp. Deuchrie at foot of Lammermuirs.

Bryum Warneum Bland. Gullane Links, July 1897. Specimens with capsules in good state for examination were determined for me by Mr. Dixon.

B. calophyllum R. Br. Gullane Links, July 1897, barren (H. N. Dixon, who kindly gave me a specimen), and Nov. 1908.

B. uliginosum B. & S. In damp hollow, Dirleton Links, 11th Aug. 1897. Identified for me by Mr. Dixon. *B. pendulum* and *B. inclinatum* are both common on the Gullane, etc., Links.

B. pallens Sw. Oldhamstocks, April 1902.

Mnium cuspidatum Hedw. Dirleton Common, Jan. 1897; a small patch coming into fruit.

M. rostratum Schrad. Ormiston Hall; Saltoun; Yester; Dunglass.

Cryphaea heteromalla Mohr. The only East Lothian record I know of is that by J. Hardy from Dunglass Pond (Moss Fl. East. Bord., 1868).

Leucodon sciuroides Schwaeg. On rocks at Hailes, near East Linton, Sept. 1908 and other dates; Yester, on poplar, Jan. 1904.

Pterogonium gracile Swartz. Rocks at Hailes, on several occasions.

Antitrichia curtipendula Brid. On an old tree, Yester, Aug. 1902.

Porotrichum alopecurum Mitt. Oldhamstocks Burn; Ruchlaw.

Climacium dendroides W. & M. Gullane Links; Lammermuirs above Castle Moffat, etc.

Camptothecium lutescens B. & S. Dirleton Common, Jan. 1897; Gullane Links, Oct. 1905.

Brachythecium glareosum B. & S. East of Port Seton (from J. M'Andrew, Nov. 1906). *B. albicans*, common on coast dunes.

B. rivulare B. & S. Above Castle Moffat, Oct. 1908.

Eurhynchium piliferum B. & S. Ormiston Hall Woods, March 1902. *E. striatum*, *E. myosuroides*, and *B. populeum* were also collected at same time.

E. Swartzii Hobk. Dirleton Common; Humbie.

E. tenellum Milde. Shaded wall east of Port Seton, May 1907.

Plagiothecium elegans Sull. Ormiston Hall Woods, Dunglass Dean; Garleton Hills.

Amblystegium Juratzkanum Schp. On sand-covered stem of saugh growing over the Birns Water, near Humbie Station, May 1903; also, though not quite typical, on similar habitat near Drem, Dec. 1904. Specimens from both localities were determined by Mr. Dixon.

A filicinum De Not. Castle Moffat; West Saltoun; sea-braes near Skateraw.

Hypnum stellatum Schreb. Luffness Marsh; Skateraw; etc

H. chrysophyllum Brid. Gullane Links, Nov. 1908.

H uncinatum Hedw. Traprain Law; Upper Bolton.

H. falcatum Brid. Luffness Marsh; sea-braes near Skateraw.

Hylocomium loreum B. & S. In fine "fruit," Boltonmoor Wood March 1904; also at Yester, Castle Moffat, Garleton Hills, etc.

Co. 83, Edinburgh.

Greville, Sadler, and others have provided records for a very comprehensive list of the Mosses of this county, the vicinity of Edinburgh having long been a happy hunting-ground for local botanists interested in this section of our flora. My own interest in the subject began in 1868 when, with Greville's Flora Edinensis as my reference book, I explored the valley of the Esk about Penicuik and the recesses of the Pentland Hills, including the "cryptogamic garden" above the waterfall at Nether Habbie's Howe. Since then the Mosses of the district have

again and again claimed my attention, leading to the frequent repetition of these health-giving and inspiring rambles. The result of all this has been the accumulation of a large amount of material bearing on the distribution of the various species in the county, and the changes in their status which time has brought about. For its proper treatment, however, this pile of data would require a separate paper, and in the present communication only a selection of the more outstanding of my records are given.

(*a*) Additions to the Census Cat. list:—

Polytrichum strictum Banks. Moss west of Ravelrig, Balerno, May 1909. In October of same year it was found on Bavelaw Moss by Mr. M'Andrew (loc. cit.) "Pentlands" is given as a locality for it in Balfour and Sadler's Flora of Edinburgh.

Dicranella heteromalla, var. **orthocarpa** Hedw., "or very near it" (Dixon). Ravelrig, near Balerno, April 1898.

Campylopus flexuosus, var. **paradoxus** Husn., "or very near it" (Dixon). Moss west of Ravelrig, April 1898.

Trichostomum tortuosum. var. **fragilifolium** Dixon. Torduff, Pentlands, March 1898. Determined by Mr. Dixon.

Orthotrichum affine, var. **fastigiatum** Hubn. On wall, Fairmilehead, June 1897.

Physcomitrella patens B. & S. This little moss was abundant at the upper end of Torduff Reservoir and also at Clubbiedean Reservoir, Pentlands, in Oct. 1908—as recorded by my son, W. Edgar Evans, in Ann. Scot. Nat. Hist. for 1909, p. 55—and on other occasions.

Webera proligera Brylın. I have seen a specimen from Roslin Glen, taken by Mr. J. C. Adam in 1916.

Cryphaea heteromalla Mohr. This curious moss is not given for Co. 83 in the Census Catalogue. I may therefore point out that in Balfour and Sadler's Flora of Edinburgh (1863, and 2nd ed. 1871) Dalkeith is given as a locality for it.

(*b*) Localities for some of the better species in the Census Cat. list. Many are additions to the list in Balfour and Sadler's Flora of Edinburgh:—

Sphagnum Austini Sull. Auchencorth Moss, 24th May 1902.

Polytrichum gracile Dicks. Kirknewton; Ravelrig and Auchencorth Mosses; etc. *P. formosum*, Ravensnook, Dreghorn, Polton, etc.

Archidium alternifolium Schp. Side of Bonaly Reservoir, April 1898; Harelaw Dam; Glencorse and Cobbinshaw Reservoirs.

Swartzia montana Lindb. On old wall, Balerno, 7th March 1894.

Seligeria Doniana C. M. On sandstone rocks, Dryden (Bilston) Glen, near Roslin, 4th April 1902.

Brachyodus trichodes Furnr. On sandstone by side of rill at the wood skirting the moor above Currie, 15th March 1904.

Dicranella cerviculata Schp. Moor east of Cobbinshaw, abundant, Aug. 1904; south side of the Almond, Craigiehall, Dec. 1904.

D. secunda Lindb. On old cart-track, Threipmuir Reservoir, May 1898; edge of Bavelaw Moss, June 1901

D. Schreberi Schp. Allermuir Glen, Pentlands, March, and *V. elata*, Ravensnook, near Penicuik, May 1902. Briech Burn, given in Balfour and Sadler's Flora of Edinburgh as a locality for this species, leaves the county—Midlothian or Linlithgow—uncertain.

Campylus fragilis B. & S. Water of Leith below Harperrig, Nov. 1897; Torduff, Pentlands, March 1898; Caerketton, Pentlands, April 1909 (W. Edgar Evans).

Dicranum Bonjeani De Not. I have only once found capsules of this common moss in this district, namely, at the upper pond, Penicuik House, in May 1871. *D. fuscescens*, Caerketton, etc.

D. strictum Schleich. On sycamores, oaks, etc., in Roslin, Hawthornden, and Dryden Woods on many occasions since I first added it to the Scottish list from Roslin Glen in April 1896 (see Ann. Scot. Nat. Hist., 1902, p. 191). Pomathorn Dean.

Fissidens exilis Hedw. South bank of Water of Leith, Redhall, Colinton, abundant, Feb. 1897; Dreghorn, March 1897.

F pusillus Wils. Vogrie Glen, on sandstone rock, abundant, Feb. 1897; Bilston Glen, April 1902; on sandstone wall, near Balerno, Oct. 1908 (W. E. Evans).

F decipiens De Not. In April 1897 I got a Fissidens at Nether Habbie's Howe, Pentlands, which Mr. Dixon determined as this species. Localities for *F. osmundoides* are Moorfoot Water, March 1904, and Dalmahoy Hill, May 1907.

Grimmia Stirtoni Schp. On low rocks, Boghall, Pentlands, March 1902.

G. ovata Schwaeg. Rocks on Braid Hills, in fine fructification, Feb. 1869 and Dec. 1908. In June 1871 I gathered on Arthur's Seat most of the rare Grimmias that had been recorded therefrom, and some of them were still in evidence in March 1902; but it is doubtful if any now remain.

Pottia recta Mitt. In flower-pot in greenhouse, Morningside Park, Edinburgh, Sept. 1904.

P. intermedia Furnr. Wall top beyond Liberton, Dec. 1878.

P. minutula Furnr. Near Currie, Feb. 1897. *P. lanceolata* used to be common on an earth-capped wall at Craiglockhart, and was very fine on an old wall near Craigmillar in the spring of 1904.

Tortula pusilla Mitt. Roadside at Fordel, near Prestonhall, abundant, Jan. 1915. This and *T. rigida* used also to occur commonly on earth-capped walls at Craiglockhart now taken down or destroyed. My latest date for them there is April 1909.

T. ambigua Ångstr. South side of glen at Roslin, Oct. 1897; in old quarries at Blackford Hill and Craigmillar. *T. aloides*, in old limestone quarry at Gilmerton, March 1902.

T. mutica Lindb. On old saugh, river Esk at Inveresk, Feb. 1903.

T. intermedia Berk. On rocky ground, Braid Hills, May 1877. *T. ruraliformis* has been found at Levenhall Links, Musselburgh; *T. laevipila* on old sycamores at Arniston, Woodhouselee, etc.; *T. princeps* on wall at Craiglockhart, March 1877, and Nether Habbie's Howe, April 1897; *T. papillosa* on rocks on Braid Hills, April 1905.

Barbula spadicea Mitt. Torduff, April 1898; Cramond. *B. rigidula*, Kirknewton, Swanston, etc. *B. lurida*, Gilmerton, 1902

B. cylindrica Schp. Ravelrig, Balerno, c. fr., April 1898; Edgelaw Glen, on wet rock, June 1902; on old wall near Dalkeith, abundant and fruiting freely, April 1905. The subspecies *B. vinealis* has for many years grown in profusion on a wall at Balerno.

B. convoluta Hedw. Side of Bonaly Reservoir, April 1898.

Leptodontium flexifolium Hampe. Caerketton (south side) and Bonaly Hill, Pentlands.

Weisia tenuis C. M. On sandstone rocks, right bank of Almond below Cramond, Feb. 1905, and Bilston Glen, April 1909 *W. mucronata* was common in an old quarry at Ravelston in Feb 1904. *W. verticillata*, Currie, June 1856 (Balfour's Excursions); near Cramond, Dec. 1903.

Cinclidotus fontinaloides P. Beauv. Almond below Cramond Brig, March 1902; Glencorse Reservoir, Dec. 1904.

Encalypta vulgaris Hedw. In 1824 Greville wrote of this: "extremely abundant on the mud-capped walls by the roadsides round Edinburgh," and it was still common thirty to forty years ago; now that these walls are practically a thing of the past, I seldom see it Fairmilehead and Crichton, 1897; Ratho; Little France, 1905; Craiglockhart, 1909. *E. streptocarpa* has, on the other hand, become much more plentiful. Greville gave only rocks, Pentland Hills and west side of Arthur's Seat, for it; now it is abundant on shady stone-and-lime walls at Gilmerton, Penicuik, Vogrie, Balerno, Dalmahoy, etc., but never seems to produce capsules. *E. ciliata* still occurs at Nether Habbie's Howe, but in greatly reduced quantity; and this also applies to most of the other good mosses found there *E. ciliata* and some others were still in Bonaly Glen less that twenty years ago.

Zygodon Stirtoni Schp. Rocks in Craiglockhart Wood, c. fr., March 1902. *Z. Mougeotii* occurred in Moorfoot Glen (along with *Andreaea petrophila*, *Weisia rupestris*, etc.) in March 1904; and near Nine-Mile Burn in May 1902. Localities for *Z. viridissimus* are Penicuik, Newhall, Arniston, Craigmillar, etc.

Ulota Drummondii Brid. On ash and hazel, Edgelaw Reservoir, June 1902, along with *U. crispa*, var. *intermedia*. *U. phyllantha* Brid., on boulder east of Cramond, May 1902. *U. Bruchii* is our commonest species of the genus.

Orthotrichum stramineum Hornsch. Little Vantage, Penicuik, Polton. *O. Lyelli*, Penicuik, Arniston, Heriot, etc. *O. diaphanum*, Braid Hills, Craigmillar, Ravensnook. *O. pulchellum*, Penicuik, Edgelaw. *O. leiocarpum*, Penicuik, Arniston.

Splachnum sphaericum Linn. fil. Bavelaw Moss, April 1878, etc.; Bonaly Hill, Currie Moor, Swanston Hill, etc.; East Cairn Hill, Sept. 1905. I have a specimen of *S. ampullaceum* from Ravelrig bog, collected by my father in July 1847.

Tetraplodon mnioides B. & S. Ridge between Scaldlaw and South Black Hill, Pentlands, 23rd May 1891 (see Ann. Scot. Nat. Hist., 1894, p. 187), and once since; Bavelaw Moss, June 1895 and 1897.

Funaria ericetorum Dixon. On side of surface-drain, Allermuir Glen, Pentlands, March 1902. From Mr. M'Andrew I understand that *F. Templetoni* was erroneously given for Co. 83 in the Census Cat. owing to a mistake regarding the locality.

Aulacomnium androgynum Schwaeg. Arniston Woods, June 1848 (from my father's collection) and Oct. 1902; in small ravine near Nether Habbie's Howe, Pentland Hills, May 1868 (W. E. in Trans. Bot. Soc. Edin., xi, p. 456); near Auchendinny (J. M'A.)

Bartramia ithyphylla Brid. Nether Habbie's Howe, April 1897, Heriot, May 1901; Moorfoot Water, March 1904.

Philonotis calcarea Schp. Fullarton Water Nov. 1897; Pentlands above Bonaly, July 1898; Polton, May 1904.

Orthodontium gracile Schwaeg. Several places in Roslin Glen, March 1900, etc. First recorded from this locality by Messrs. Scott and Murray in 1898 (Ann. Scot. Nat. Hist. and Trans. Edin. Field Nat. Soc.)

Webera commutata Schp. On old cart-track, Threipmuir Reservoir, May 1898. Mr M'Andrew gave me Fountainhall Quarry, Ravelston, April 1904, as a locality for *W. annotina*. I have *W. albicans* from Penicuik, Arniston, Roslin, Bonaly Hill, etc.; and *W. carnea* from Penicuik, Polton, and Dalhousie.

Plagiobryum Zierii Lindb. Still exists at Nether Habbie's Howe; ravine west of Swanston, Feb. 1898.

Bryum filiforme Dicks. Moorfoot Water, March, and Bonaly Glen, Oct. 1904. Localities for *B. pallens* are Penicuik, Loganlee; Polton, Moorfoot Water, and Harburn; and for *B. bimum*, Allermuir Burn, Pentlands, Dec. 1900; Bonaly Glen, Oct. 1904.

B. intermedium Brid. South bank of Esk at Roslin, Oct. 1897.

B. alpinum Huds. Roadside west of Balerno, March 1894, etc.; Dalmahoy Hills, April 1899; Nether Habbie's Howe, April 1902.

B. roseum Schreb. Penicuik Woods, Nov. 1868; Craiglockhart, March 1902; Arniston, Oct. 1905.

Mnium affine Bland. At foot of wall, Morton, March 1898.

M. Stellare Reich. Craiglockhart Wood, March 1902.

M. subglobosum B. & S. Pentlands west of Swanston, in fine fruit, 1st Jan. 1897, etc.; Bonaly Hill and Dalmahoy Wood, 1898; head of Logan Water, April 1902.

Fontinalis antipyretica L., var. **gracilis** Schp. Gutterford Burn, Pentlands, Oct. 1905.

Neckera crispa Hedw. I fear this fine moss no longer grows at Nether Habbie's Howe; my last date for it there is April 1902. In 1899 there was still a very little of it in Bonaly Glen.

Pterygophyllum lucens Brid. Penicuik and Dryden Woods; Fullarton Water; etc.

Leucodon sciuroides Schwaeg. Arthur's Seat, June 1871; Blackford Hill; Arniston and Rosebery; Craiglockhart; Craigmillar.

Pterogonium gracile Swartz. Blackford Hill, last seen in 1900; Braid Hills; Craiglockhart, March 1902. So long ago as 1792 it was recorded from Arthur's Seat by Lightfoot.

Antitrichia curtipendula Brid. Penicuik, on an old sycamore, c. fr., 1869, etc. On revisiting this locality about twenty years ago, I found the tree gone.

Leskea polycarpa Ehrh. On willows and stones, Glencorse Reservoir, Dec. 1904, etc.

Anomodon viticulosus H. & T. Still exists, or did so a few years ago, at Craigmillar Castle and Craiglockhart.

Heterocladium heteropterum B. & S. Roslin Glen, March 1900; var. *fallax*, Bilston Glen, Feb. 1903.

Orthothecium intricatum B. & S. Still at Nether Habbie's Howe; Torduff, last seen March 1902; foot of Glencorse Reservoir, Sept. 1901.

Camptothecium nitens Schp. Fullarton Water, above Edgelaw, 21st April 1870; near head of Logan Water, Pentlands, Nov. 1903, etc.; north side of Carnethy, Oct. 1904. Records for *C. lutescens*, B. & S., are Vogrie Glen, in profusion and fruiting abundantly, Feb., Bonaly Hill, March, and Fullarton lime-quarries, Nov. 1897; Gilmerton, March 1902.

Brachythecium salebrosum B. & S., var. **palustre** Schp. Ditch by side of Threipmuir Reservoir, c. fr., Dec. 1899.

B rivulare B. & S. Bonaly Glen, June, and Fullarton Water, Oct. 1898; side of Carnethy, Oct. 1904; well-head, Allermuir Burn, April 1909.

Eurhynchium crassinervium B. & S. Braid Hermitage; Craiglockhart Hill Wood, June 1902. *E. Swartzii* Hobk., Craigmillar, and near Loanhead, Jan. 1897. *E. murale* Milde, wall at Braidburn, but disappeared a good many years ago; Gilmerton Quarry; Dalkeith, April 1905. *E. tenellum*, Craiglockhart, 1902.

Plagiothecium depressum Dixon. Bilston Glen, April 1902. *P. elegans* Sull., Polton Woods, April 1898, etc.; Penicuik Woods, May 1911; Caerketton.

Amblystegium irriguum B. & S. East bank of Esk at Carlops, May 1902. *A. fluviatile* B. & S., Water of Leith near Donaldson's Hospital. *A. filicinum* De Not., Dalhousie Burn; Allermuir Burn; Bush, near Roslin.

Hypnum stellatum Schreb. Pentlands, c. fr., April 1868; Pomathorn Moor, c. fr., May 1869, etc.; var. *protensum*, walls near Kirknewton, etc.; Gilmerton Quarry, March 1902.

H. chrysophyllum Brid. Allermuir Glen, Pentlands, Dec. 1900.

H. fluitans L. Auchencorth Moss, in fine fruit, June 1885; Castle Law, Pentlands, etc. *H. uncinatum*, Corstorphine Hill; Newpark, etc.

H. falcatum Brid. Bonaly Glen, June 1898, south side of Carnethy and elsewhere on the Pentlands.

H. cupressiforme L., var. **resupinatum** Schp. Braid Hills, c. fr., May 1877; Craiglockhart Hill; Hawthornden. Var. *ericetorum* B. & S. is common on the Pentlands.

H. Patientiae Lindb. Loganlee, Pentlands, 1897, etc., Harperrig, Oct. 1905.

H. crista-castrensis L. Bavelaw fir-wood, May 1898, etc.

H. eugyrium Schp. Clubbiedean, March, and Nether Habbie's Howe, April 1897. *H. ochraceum* Turn is common in the Logan Water, Gutterford Burn, Crosswood Burn, etc., on the Pentlands.

H. scorpioides L. Pomathorn Moor, May 1869.

H. stramineum Dicks. Loganlee, Pentlands, c. fr., May 1869, etc.; Bavelaw Moss, Aug. 1898, etc.; *H. cordifolium* Hedw., Duddingston Loch, c. fr., April 1878; near Bavelaw; Ravensnook.

My Co. 84 (Linlithgowshire) records, in so far as they are additions or relate to the less common species, are, as previously mentioned, incorporated in Mr Adam's list (*antea*, p. 123).

I have also a large number of records from Vice-Co. 85 (Fife with Kinross) and Vice-Co. 87 (West Perth with Clackmannan), but these are outside the scope of this paper. Allusion, however, may be made to the occurrence of **Dicranella curvata* Schp. in an old limestone quarry on Bishop Hill, Lomonds, April 1901; of *Andreaea alpina* Smith, **Hedwigia imberbis* Spruce, *Grimmia decipiens* Lindb., and **Trichostomum mutabile* Bruch, on the Ochils near Alva, May 1897; *Rhabdoweisia fugax* B. & S., *Splachnum vasculosum* L., *Bryum Duvalii* Voit, *Orthothecium rufescens* B. & S. on south side and *Oligotrichum hercynicum* Lam. on summit of Ben Cleuch, Ochils, May 1901; *Diphyscium foliosum* Mohr, *Rhabdoweisia denticulata* B. & S., *Campylopus atrovirens* De Not., *Rhacomitrium protensum* Braun, **Bryum bimum* Shreb. and *Hypnum sarmentosum* Wahl. on Ochils behind Dollar, April 1897; **Camptothecium lutescens* B. & S. and *Eurhynchium crassinervium* B. & S. behind Menstrie. April 1909; and **Hypnum cordifolium* Hedw., near Tullibody, May 1909. Those marked * are additions to the Census lists. *S. vasculosum*, it should be said, was recorded from King's Seat Hill, Ochils, in July 1891 by Dr. Buchanan White (Proc. Perth. Soc. Nat. Sc., 1, cxxvi). For some Isle of May records see Trans. Bot. Soc. Edin., xxiii, p. 348 and xxiv, p. 91.

APPENDIX.

Further Additions to the Selkirkshire List.

Since the foregoing paper was drawn up I have collected the following twelve additions to the Co. 79 list at Selkirk, namely :—

Ditrichum flexicaule Hampe. On calcareous bank at roadside south of Selkirk.

Barbula rigidula Mitt. On old wall near Selkirk.

B. revoluta Brid. On wall close to Selkirk.

B. convoluta Hedw. Roadside near Selkirk.

Tortula laevipila Schwaeg. On elm near Selkirk.

Encalypta streptocarpa Hedw. On wall in Selkirk and on rocky bank by roadside south of the town.

Orthotrichum stramineum Hornsch. On sycamore at roadside near Selkirk.

Bryum argenteum L. Common on footpaths in Galashiels and Selkirk and on field-path near the latter town.

Brachythecium glareosum B. & S. On calcareous bank at roadside south of Selkirk.

Eurhynchium Swartzii Hobk. In field near Selkirk.

Amblystegium filicinum De Not. In marshy ground beside pond near Selkirk.

Hypnum falcatum Brid. In same locality as the last.

Specimens of these further additions have been submitted to Mr. Meldrum.

In 1909 Mr. S. M. Macvicar collected a number of Mosses in the upper part of Yarrow, among them being the following further additions to the county list :—*Sphagnum rigidum* Schp., *S. intermedium* Hoffm., *Andreaea petrophila* Ehrh., *A. Rothii* W. & M., *Dichodontium pellucidum* Schp., *Fissidens decipiens* De Not., and *Zygodon Mougeotii* B. & S. (J. M'Andrew, in lit., 12th July 1909)

Funaria ericetorum and *Bryum filiforme* were collected by me near Selkirk, Aug. 1903, and at Crosscleuch Burn, near St. Mary's Loch, Aug. 1907 respectively, and are both included in the Census list.

It might have been thought that the romance of Yarrow would have drawn more bryologists to explore its "Braes" and "Dowie Dens."

RHODODENDRONS OF THE IRRORATUM SERIES. By Professor BAYLEY BALFOUR, F.R.S.

(Read 8th February 1917.)

The series of Rhododendrons which we may call Irroratum, after the first described species included in it, has a wide area of distribution in Yunnan, and to our present knowledge extends only into Eastern Upper Burma over the Yunnan frontier. Its extreme limits in Yunnan as known are Mengtsz in the south-east, Tengyueh in the west, Tseku in the west-north-west, and the Chungtien plateau in the east-north-west. Fourteen species of the series are known. The following list gives their names, the distribution of each, and the name of its discoverer:—

Rh. adenostemonum, Balf. f. et W. W. Sm.	S.E. Yunnan.	N. of Mengtsz. 8500 ft. (Henry.)
Rh. agastum, Balf. f. et W. W. Sm.	W. Yunnan.	Shweli - Salween divide. 7000–9000 ft. (Forrest.)
Rh. anthosphaerum, Diels.	E.N.W. Yunnan.	Sungkwei pass. 10,000–11,000 ft. (Forrest.)
Rh. araiophyllum, Balf. f. et W. W. Sm.	W. Yunnan.	Shweli - Salween divide. 9000–10,000 ft. (Forrest.)
Rh. ceraceum, Balf. f. et W. W. Sm.	W.N.W. Yunnan.	Tseku. (Monbeig.)
Rh. eritimum, Balf. f. et W. W. Sm.	E.N.W. Yunnan.	Chungtien plateau. 9000 ft. (Forrest.)
Rh. gymnanthum, Diels.	W.N.W. Yunnan.	Tseku. 13,000 ft. (Forrest.)
Rh. hylothreptum, Balf. f. et W. W. Sm.	E.N.W. Yunnan.	Sungkwei pass. 11,000–12,000 ft. (Forrest.)
Rh. irroratum, Franch.	Mid. N.W. and E.N.W. Yunnan.	Tali range to the Chungtien plateau. 9000–12,000 ft. (Delavay.)
Rh. lukiangense, Franch.	W.N.W. Yunnan.	Tseku. (Soulie.)
Rh. mengtszense, Balf. f. et W. W. Sm.	S.E. Yunnan.	S.E. of Mengtsz. 7000 ft. (Henry.)
Rh. pogonostylum, Balf. f. et W. W. Sm.	S.E. Yunnan.	N. of Mengtsz. 7000–8500 ft. (Henry.)
Rh. spanotrichum, Balf. f. et W. W. Sm.	S.E. Yunnan.	Fengchenlin Mts., S.W. of Mengtsz. 7500 ft. (Henry.)
Rh. tanastylum, Balf. f. et Ward.	E. Upper Burma.	Hpimaw. 9000–10,000 ft. (Ward.)

Two of these species are in cultivation—*Rh. hylothreptum* and *Rh. irroratum*. A third plant belonging to the series

was also in cultivation, and flowered at Kew in 1907, but it has not yet been described.

The specimens of the series which I have had for examination are far from complete. Of one only is there certainly fruit. In only four species are the important foliage-bud stage and the unfolding young leaves present. I cannot hope in the circumstances to give an exhaustive account of the species, but it may help the progress of our knowledge if I state what I know of them, imperfect though the statement must be.

The plants are shrubs or small trees reaching a height at maximum of some 9 meters, with usually not very thick terminal branchlets—sometimes these are quite thin (*Rh. araiophyllum*). The shoots after the juvenile stage appear to be glabrous in most species and are commonly so described, but in *Rh. pogonostylum* an indumentum covers the one-year old stems. Glabrescent would be the more correct term. The leaves with short petioles from 1·5–2 cm. long (barely 1 cm. *Rh. eritimum*, 1 cm. only *Rh. araiophyllum*) are lanceolate, oblanceolate or oblong, have a cartilaginous margin flat or slightly recurved and always more or less undulate, sometimes notched sometimes only asperate. The leaf apex in the lanceolate and oblanceolate forms tapers to a longish point, in the oblong forms (*Rh. agastum*, *Rh. eritimum*) is more or less suddenly contracted into a beak-like extremity; the midrib runs out in all to the end of the leaf and enlarges into a small horny hydathodal tubercle which, conspicuous in young leaves and forming a distinct mucro, is in the old leaves overgrown as it were by the lamina and covered by it. The base of the leaf is cuneate or narrowly obtuse in the lanceolate forms, more broadly obtuse in the oblong, quite rounded in *Rh. pogonostylum*. The upper surface may be glaucous green (*Rh. adenostemonum*, *Rh. gymnanthum*, *Rh. irroratum*), more commonly an olive green, sometimes showing a reddening along the course of the midrib and primary veins (*Rh. ceraceum*); sometimes in the older leaf becoming quite a dark brown (*Rh. adenostemonum*). The under surface is more variable, passing from glaucous (*Rh. eritimum*) through straw-coloured (*Rh. pogonostylum*, *Rh. spanotrichum*) and fawn

(*Rh. anthosphaerum*, *Rh. irroratum*) to tawny shades (*Rh. agastum*, *Rh. araiophyllum*, *Rh. ceraceum*, *Rh. hylothreptum*, *Rh. lukiangense*, *Rh mengtszense*, *Rh. tanastylum*) to cinnamon (*Rh. adenostemonum*). Apparently several shades may be exhibited by one species according to age. Three species stand out from their fellows by the particularly glossy character of the leaf-surface due to a wax coating. *Rh. gymnanthum* has the upper surface as if polished—a useful character for discriminating it at sight from *Rh. mengtszense* in which the form of foliage though larger is somewhat similar,—and *Rh. ceraceum* and *Rh. lukiangense* have the under surface as if varnished. *Rh. araiophyllum*, *Rh. mengtszense*, *Rh. spanotrichum*, and *Rh. tanastylum* have also the under surface somewhat glossy. Wax is, I believe, an epidermal formation in all species of the section, only making itself conspicuous by giving a glossy aspect in these cases I am naming here. For a study of its development growing plants are required. The poisoning of herbarium specimens with alcoholic solutions must alter the appearances As it appears the wax is an infiltration of the outer cuticle out of which it can be dissolved by benzole or other suitable solvent This is a different relation from that in species where the leaf surface has a white or grey bloom, *e.g.* in *Rh. formosum* or in the Lapponicum series. There epidermal papillae are developed standing out from the leaf surface, and upon the outside of these white wax granules cluster. There is no varnishing of the surface as there is here in the Irroratum series. One surface (the under) or both surfaces are to correct observation conspicuously although minutely punctulate in all species save perhaps in *Rh. ceraceum* and *Rh. lukiangense* Apparently *Rh. araiophyllum* has no punctulations on the under surface apart from the midrib and veins. Minute red or orange spots are distributed on midrib, primary veins, and the general reticulation of the surface, and these may be seen also on the cartilaginous margin. For an understanding of this feature we must go to the buds and the young leaves as they expand. The ptyxis of the leaves is revolute, the young leaves standing in a cluster in the middle of the bud-chamber after the fashion in all the large-leaved

evergreen species of Rhododendron. The revolution of the lamina makes the upper surface the exposed one, excepting the midrib (here raised) of the under surface against which the curled sides of the lamina abut. The upper surface and the exposed midrib area of the under side are in the four species (*Rh. agastum*, *Rh. araiophyllum*, *Rh. hylothreptum*, *Rh. irroratum*), of which alone we know the young leaves, densely clad with indumentum. Its elements may be hairs with a stout foot and branching freely above, often very long and interwoven, white at first and becoming more or less orange or red, and taking on the greasy appearance so often seen in Rhododendrons (*Rh. agastum*, *Rh. araiophyllum*). The whole surface may thus be what is known by the generic term tomentose, and this tomentum, composed of flocks of greasy hairs, is a floccose greasy tomentum. Or there may be an admixture of clavate-stalked red glands with similar stout bases (*Rh. hylothreptum*) and the glands may predominate (*Rh. irroratum*). The same covering may spread over the petiole. The under leaf-surface, concealed by the rolling backwards of the sides of the leaf, bears also floccose hairs with stout bases, but they are fewer, not in contact, and the branches are shorter, more prostrate and radiating: there may also be clavate glands and cauliflower glands (In *Rh. araiophyllum* the under surface appears to be glabrous except on the primary veins and midrib.) Along the margin glands and flocks are also developed. As the leaves unfold the glands and the flocks fall off always above the foot or base, which remains as a red or orange-coloured cone blackening with age, and is the cause of the punctulation of the leaf-surface in the mature leaf. Punctulations on the petiole and on the stems are developed in like manner. In no species, with the exceptions hereafter mentioned, have I seen the juvenile indumentum persisting throughout on the mature leaves and petioles and stems. But if my description has made clear the happenings during the passage from youth to maturity, the persistence of some part of the indumentum in a more or less perfect state is an occurrence that will not cause surprise. In some species this persistence is more marked than in others. *Rh. agastum* retains as a thin

scurfy indumentum layer the floccose hairs on the under surface of the leaf, *Rh. araiophyllum* has often shreds or patches of indumentum adhering to the veins on the under leaf-surface, as has also sometimes *Rh anthosphaerum*; *Rh. hylothreptum* has often glands on the lower midrib which may be also slightly puberulous. The places where vestiges (apart from the punctulae) remain most constantly are the groove of the upper midrib and of the petiole and the petiole itself. *Rh. irroratum* is one of the species which seems to get rid of most of its early indumentum, yet in plants from the Chungtien plateau quite a stratum of grey withered indumentum may remain on stem and petiole. In *Rh. pogonostylum* this stratum in the few specimens we have remains for a couple of years There is room here for considerable variation in individual plants and from what I have said the point of my comment that glabrescent, not glabrous, is the more correct descriptive term to use in speaking of the mature state in these species will be apparent I must add this. In some species the vestigial cones of the fallen glands or hairs are hard to find even under some considerable magnification on the upper leaf-surface. One can hardly speak of the surface as punctulate. Apparently the vestigial cones are very low and do not colour red or orange, and are thus inconspicuous. I have not sifted this matter. Then the vestigial cones on the leaf margins are more feebly developed in some species than in others. *Rh irroratum* offers an example of conspicuous development, so much so that the projection of these cones associated with the slight undulation gives an appearance of notching to the leaf margin which is very characteristic. Where the vestiges are smaller the effect they give is that of a roughening of the edge. This juvenile indument character and its graded removal is most typical of the Irroratum series Although I have been able to trace the development in only four out of the thirteen species, yet the similarity in mature characters of all of them seems to demand the same explanation, and I feel justified in assuming that when the material required for investigation is obtained it will support my prediction of like development.

Two modifications have to be recorded.

Rh. mengtszense differs from its fellows in respect of this indumental character by bearing on its mature leaf-petiole and stems setae and gland-setae as a dense persistent and thick coating. It is quite strigillose. Traces of these setae are to be found upon and about the midrib, both above and below the leaf, particularly towards its base, and very large punctulations occur all over the veins, so that I have no difficulty in correlating this exceptional setose condition as a special development within the typical evolution.

Rh. ceraceum and *Rh. lukiangense* appear more exceptional. The leaf-surfaces here show no conspicuous red punctulation, though there are traces of it, but are covered with a skin of wax so prominent as to give them a smooth aspect on the under side as if varnished. The glossiness is less on the upper side. The stem is also wax-covered, and so is the petiole, and when the stem and petiole shrivel in drying the wax stratum scales off the surface in a series of flakes which are found coating the parts as a white crust. There are no hairs or glands or their vestiges visible on the blades, petioles, and stems of this species. Certain marks on the leaf-margin suggest vestiges of glands or hairs, but not certainly, and we do not know the bud condition of the species. These indumental characters in *Rh. ceraceum* and *Rh. lukiangense* are not fundamentally different from those in the rest of the series. There is only an excess of wax and reduction in other indumental elements. Suspicion, however, of its position as one of the series might be aroused. In all its other features it seems to show its descent in common with those of the Irroratum series. Whilst I think that the feature of indumentum has been too much overlooked by workers amongst Rhododendrons, I do not subscribe to any overrating of its value as a phyletic character. It has not apparently always the same construction in forms belonging to the same phylum, no more than it has in other genera. But differential—and critically so—it is in some cases where the appraisement of other characters has in the past proved faulty for specific determination. I will say this, that two plants in which the construction of the indumentum is different are not the same species, and conversely, two plants which have indumentum of the same construction

may be of different species. In a phylum such as that of Irroratum the indumentum in most of the forms is constructed on the same lines, but that does not keep us from recognising specific segregation amongst the forms based upon other diagnostic characters. At present we are only on the threshold of the study of indumentum in Rhododendron. In the example of this Irroratum series with which I am dealing I see differences in the punctulations of the mature leaves which I have no doubt would add to the sum of differential characters of the species had one only time and eyes to follow out an investigation of them. This will be one of the necessary tasks of a future monographer of Rhododendron. Meanwhile Mr. H. F. Tagg, Assistant in the Museum of the Royal Botanic Garden, Edinburgh, is devoting some time to the study of the forms exhibited by the indumentum in Rhododendron, and has obtained some interesting results. I had hoped, having the advantage of the co-operation of Mr. R. M. Adam, Assistant in the Studio here, whose skill as a photographer is unrivalled, to have been able to provide a series of illustrations from microspecimens of typical forms of indumentum, and many of them have been prepared, but he is now doing more valuable work in serving the guns, and who shall say that our intention will reach fruition.

It may not be amiss to mention here that most of these species of the Irroratum series seem to be infested by a fungus which sends out upon the under leaf-surface in particular small black rod-like conidiophores, upon which conidia are seldom seen, except under shelter of the midrib. These conidiophores look like solitary black setae upon a small black cushion, and must not be confused with real appendages of the Rhododendron itself. Large black spots and tubercles of fungal origin are also abundant sometimes upon the leaves.

Turning now to the inflorescence and flower of the Irroratum series.

The typical form of the inflorescence is a compact globular truss of many flowers arranged on usually short pedicels one centimeter or under long in *Rh. adenostemonum*, *Rh. ceraceum*, *Rh. eritimum*, *Rh. gymnanthum*, *Rh. lukiangense*, *Rh. pogonostylum*, *Rh. spanotrichum*; in the

others not over one and a half centimeters, excepting *Rh. mengtszense* (2 cm.). The truss is racemose-umbellate, with a rhachis varying from one centimeter or even less in *Rh. mengtszense* and *Rh. anthosphaerum* to three centimeters in *Rh. irroratum*; in most of them it is about one and a half centimeters long. The clothing of this rhachis is not the same in all. It is glandular (*Rh. adenostemonum*, *Rh. irroratum*), floccose (*Rh. anthosphaerum*, *Rh. araiophyllum*, *Rh. eritimum*, *Rh. hylothreptum*, *Rh. pogonostylum*), floccose glabrescent (*Rh. gymnanthum*), tomentosely and persistently floccose (*Rh. ceraceum*, *Rh lukiangense*), scurfy (*Rh tanastylum*); floccose glandular (*Rh agastum*), gland-setose (*Rh. mengtszense*); glabrous (*Rh spanotrichum*). These are the features as they appear in the dried specimens, but owing to lack of material I am not confident that they are truly representative I see, for example, in *Rh. adenostemonum* traces of a tomentum under the insertion of some of the pedicels, but am unable to determine whether these are vestiges of an early tomentum covering the whole rhachis, are localised axillary tufts to the bracts such as one finds in many species of Rhododendron in which the rhachis is not tomentose, or are portions of the hair-tufts which coat the inside surface of the base of the bracts and which have become adherent to the rhachis or base of the pedicel.

I have seen no perfect flower buds, but from bracts which have remained during the earlier stages of anthesis, I gather that the outer bracts are more or less rotundate, more or less crustaceous and coriaceous, have the central portion somewhat concave inwardly, with the margin thinner, and are more or less glandular on the outside. The inner fertile bracts seem fairly uniformly oblong, wedge-shaped, somewhat truncate at the top, always densely and whitely sericeous outside, and sometimes also glandular towards the apex. The bracteoles are often longer than the pedicels, and are not glandular. The pedicels, like the inflorescence rhachis, vary in clothing.—glabrous (*Rh. araiophyllum*, *Rh. lukiangense*), puberulous (*Rh. ceraceum*); floccose (*Rh spanotrichum*, *Rh tanastylum* or glabrous)· floccose glabrescent (*Rh eritimum*, *Rh. gymnanthum*); glandular (*Rh. agastum*, *Rh. irroratum*); glandular floccose

(*Rh. anthosphaerum*, *Rh. hylothreptum*, *Rh. pogonostylum*); gland-setose (*Rh. mengtszense*) and the degrees of persistence of the several indumenta is also somewhat variable.

The series includes Rhododendrons with very small calyx—cup-shaped and fleshy with almost obsolete lobes—and it is glandular (*Rh. agastum*, *Rh. irroratum*); glandular and floccose (*Rh. anthosphaerum*, *Rh. pogonostylum*); glandular and puberulous (*Rh. adenostemonum*, *Rh. hylothreptum*); puberulous (*Rh. ceraceum*); gland-setose (*Rh. mengtszense*); glabrous and flock-fringed (*Rh. araiophyllum*, *Rh eritimum*, *Rh. gymnanthum*, *Rh. tanastylum*); glabrous (*Rh. lukiangense*, *Rh. spanotrichum*).

In the matter of the corolla, which is most commonly tubular-campanulate — openly campanulate (*Rh. araiophyllum*, *Rh. mengtszense*, and perhaps, *Rh. spanotrichum*) and tunnel-campanulate (*Rh. adenostemonum* and *Rh. gymnanthum*)—much variation in size is sometimes shown within one species. For instance, in *Rh irroratum* it may be 4 cm long or as much as 5·5 cm. The bottom of the tube is always gibbous and retuse. The size of the lobes varies with their number. Five lobes seem to be typical of the Irroratum series, but departures from this number are found in *Rh. anthosphaerum* (5–6), *Rh. agastum* (5–7), *Rh eritimum* and *Rh. hylothreptum* (7), and in the 5-lobed forms the lobes seem to be larger than in the others. It is evident that a small series of dried specimens is inadequate for the certain determination of petal numbers in forms showing fluctuations such as appear in *Rh. agastum* and *Rh. anthosphaerum*, and counts made in many more specimens are required. Colour character in the corolla divides the series in two. In most of the species it is some shade of red, often dark, in three species (*Rh. adenostemonum*, *Rh araiophyllum*, *Rh. irroratum*) it is white sometimes suffused pink on the outside, in *Rh. irroratum* often pale yellowish or greenish white, in *Rh. pogonostylum* pink. Blotching and spotting are found, but dried material is not always a safe guide in this character. So far as I am able to decide from our material the distribution is:—no blotch and no spots (*Rh. ceraceum*), blotch and spots (*Rh. anthosphaerum*, *Rh. araiophyllum*, *Rh. gymnanthum*, *Rh. hylothreptum*, *Rh. tana-*

stylum), blotch and no spots (*Rh. agastum*, *Rh. eritimum*, *Rh. mengtszense*, *Rh. spanotrichum*), spots and no blotch (*Rh. adenostemonum*, *Rh. irroratum*, *Rh. lukiangense*, *Rh. pogonostylum*). In *Rh. araiophyllum* a basal posterior large blotch has a beautiful rich dark crimson tint. There are no data through which to correlate some diagnostic characters of clothing of the corolla to which I will now refer, characters which doubtless have a relation to protection in the flower or to attraction in connection with pollination. *Rh. irroratum* is exceptional in having red glands distributed on the outside of the corolla, and they are present also in *Rh. pogonostylum* in addition to basal hairs. These are red clavate glands with short stalks, and are mostly seen upon the midrib of the petaline segments and often conspicuously on the back of the lobes. Occasionally they are absent from one or other of the petaline segments, present in the unfolding, but they seem in some cases to fall off as the corolla expands. These glands offer a readily observed mark of distinction within the series, and are in particular useful for separating *Rh. irroratum* from its nearest ally *Rh. adenostemonum*, which bears glands upon the staminal filaments and not upon the corolla. As a consequence perhaps of this glandular state in these two species, I find their flowers are much more insect-eaten than those in other species. *Rh. pogonostylum* is an exception also, for the corolla outside is puberulous at the base. Then the inside of the corolla tube in the series shows two states. In less than one-half of the species (*Rh. adenostemonum*, *Rh. agastum*, *Rh. anthosphaerum*, *Rh. hylothreptum*, *Rh. irroratum*, *Rh. pogonostylum*) it has a greater or less covering of hairs; in the rest (*Rh. araiophyllum*, *Rh. ceraceum*, *Rh. eritimum*, *Rh. gymnanthum*, *Rh. lukiangense*, *Rh. mengtszense*, *Rh. spanotrichum*, *Rh. tanastylum*) the inside of the tube is glabrous. I suspect there is some correlation between these hairs and the red blotch which is always gland-secreting, but have no observations to record.

Diplostemony gives to most of the species of the Irroratum section 10 stamens. In *Rh. eritimum* and *Rh. hylothreptum*, which have 7 petals, there are 14 stamens. Fluctuations from 10–12 stamens are found in *Rh. agastum* and *Rh. anthosphaerum*. Although 7 petals occur in *Rh. agastum* I have

not found 14 stamens. The stamens are always unequal in length, the longest usually about a centimeter longer than the shortest, but in *Rh. gymnanthum* and *Rh. spanotrichum* the difference is quite 2 cm. The longest stamens in the series are those of the larger flowers in *Rh. irroratum*. They may be 4·5 cm. long, whilst in the shorter flowers of that species they are only 3 cm. *Rh araiophyllum*, which has the smallest flowers of all the species, has stamens showing smallest dimensions—the longest only 2·8 cm. long. In four of the species the filaments are glabrous (*Rh. eritimum*, *Rh. lukiangense*, *Rh. spanotrichum*, *Rh. tanastylum*). Diels assigns glabrous filaments to *Rh. gymnanthum*, but hairs are present, few perhaps, and only developed a short distance above the base of the filaments—in other species which have hair-appendages to the filaments they start from the very base; there is no naked base to the filaments as in some other series of Rhododrendron. The hairiness of the filaments in these other species may amount to puberulousness only, often in very fine degree (*Rh. anthosphaerum*, *Rh. ceraceum*, *Rh. irroratum*, *Rh. mengtszense*), or may be a true pubescence (*Rh. adenostemonum*; *Rh. agastum*, *Rh. araiophyllum*, *Rh. hylothreptum*), and it is usually confined to the base of the filament up to about the top of the ovary. In *Rh. adenostemonum*, *Rh. hylothreptum*, and *Rh. pogonostylum* it extends much further up the filament to its middle or beyond that, and in *Rh. adenostemonum* we have this unique feature, that mixed with the hairs and above the limit to which they reach are red, shortly-stalked glands—an unusual occurrence.

The character of the disk is not sufficiently taken note of in Rhododendrons. Measurements of the ovary include sometimes I think the disk, and where it is very hairy the character may easily be assigned to the ovary In the Irroratum series the disk is short and smooth, quite glabrous (*Rh. anthosphaerum*, *Rh. araiophyllum*, *Rh. eritimum*, *Rh. gymnanthum*, *Rh. irroratum*, *Rh. pogonostylum*, *Rh. spanotrichum*, *Rh. tanastylum*); hairy in degrees of pubescence and puberulousness (*Rh. adenostemonum*, *Rh. ceraceum*, *Rh. hylothreptum* (minutely), *Rh. lukiangense*, *Rh. mengtszense*); floccose (*Rh. agastum*).

The gynaeceum is a little longer than the stamens and

always shorter than the corolla. The ovary is narrow, cylindric, or somewhat conoid, black on the surface and usually grooved, varying in length from 5–7 mm. It may be glabrous (*Rh. eritimum*, *Rh. gymnanthum*, *Rh. hylothreptum* (sometimes floccose), *Rh. lukiangense*, *Rh. tanastylum*); puberulous (*Rh. araiophyllum*, *Rh. ceraceum*); floccose (*Rh. anthosphaerum*, *Rh. spanotrichum*); glandular (*Rh. agastum*, *Rh. irroratum*); glandular above floccose below (*Rh. adenostemonum*); floccose so densely as to conceal an under glandular layer (*Rh. pogonostylum*); gland-setose (*Rh. mengtszense*). In four species (*Rh. adenostemonum*, *Rh. agastum*, *Rh. irroratum*, *Rh. mengtszense*) the style is glandular throughout, in *Rh. pogonostylum* it is densely floccose as well as glandular throughout; in all the others glabrous. In *Rh. anthosphaerum* the flocks of the ovary sometimes spread on to the base of the style; only a few, however, appear there, and the style is rightly described as glabrous. Usually the style expands slightly, and gradually passes into the lobulate stigma seated on its summit and not wider than the style itself, but in *Rh. agastum* the stigma is relatively massive and forms a broad discoid body somewhat spongy which overhangs the sides of the style.

I have seen fruit and seed only in *Rh. pogonostylum*. The capsule is large and thick, some 4 cm. long by 1 cm. in diameter, and is slightly curved, black, and showing the remains of the ovarian indumentum. A fruiting specimen of another undescribed undoubted member of the series suggests this is not the only type The seeds are flattened oblong, about 3 mm. by 1 mm., with a wing all round and a white chalazal crest.

The species seem to fall into four small alliances within the series:—

1. *Irroratum* type—plants with rigid, pointed leaves and white or pink flowers—includes:
   Rh. adenostemonum, *Rh. irroratum*, *Rh. pogonostylum*.
2. *Gymnanthum* type — plants with narrow, papery (not in all), pointed leaves and white or red flowers—includes:
   Rh. araiophyllum, *Rh. gymnanthum*, *Rh mengtszense*, *Rh. spanotrichum*, *Rh. tanastylum*.
3. *Anthosphaerum* type—plants with broad, thick, parchmenty, pointed leaves and red flowers—includes:
   Rh. anthosphaerum, *Rh. ceraceum*, *Rh. hylothreptum*, *Rh. lukiangense*.

4. *Agastum* type—plants with rigid, blunt leaves and red flowers—includes:
Rh. agastum, *Rh. eritimum*.

Irroratum.

Here the foliage is rigid, thick, and coriaceous, the shape of the leaf lanceolate or oblong lanceolate or ovate lanceolate, sometimes somewhat oblanceolate, with the marginal undulation very distinct and the notching from the fallen glands and flocks conspicuous. The stem and petioles whilst glabrescent retain often the flocks and glands of youth. This little group is markedly glandular, and the punctulations caused by the fallen glands are easily seen. Pedicels, calyx, ovary, style—all have glands sometimes mixed with flocks. The corolla is glandular outside in *Rh. irroratum*, the stamens in *Rh. adenostemonum*; in *Rh. pogonostylum* there are glands outside the corolla, as in *Rh. irroratum*, though fewer, and also a coating of hairs. The flowers are white or yellowish-white, with a flush of rose, or are pink, are in dense many-flowered raceme-umbels, have 5 petaline lobes and 10 stamens The species cover the area from the north-west of Yunnan to the south-east.

KEY TO THE SPECIES

Leaves rigid, thick, coriaceous, lanceolate oblanceolate or ovate-lanceolate, base obtuse or rounded, mat on both surfaces, margin conspicuously undulate and notched.
Corolla 5-lobed, glabrous glandular or glandular and puberulous outside, puberulous inside, spotted, not blotched. Stamens 10. Style glandular or floccose and glandular.
Calyx glandular. Style glandular
Corolla white or cream or suffused rose.
Ovary glandular Pedicel 1 cm. or more glandular.
Corolla tubular-campanulate glandular outside. Stamens finely puberulous at base, eglandular Inflorescence rhachis glandular. Petiole glandular and floccose glabrescent . . . . . *irroratum*
Ovary glandular with some flocks Pedicel under 1 cm. glandular.
Corolla funnel-campanulate glabrous outside. Stamens pubescent to middle and beyond, glandular. Inflorescence rhachis glandular and floccose (?). Petiole gland-glabrescent . . . . . *adenostemonum*

Calyx densely floccose and glandular. Style floccose and glandular.
Corolla pink.
Ovary densely floccose and with glands. Pedicel under 1 cm. floccose and glandular.
Corolla tubular-campanulate glandular and puberulous outside, puberulous inside. Stamens pubescent to middle and beyond eglandular. Inflorescence rhachis floccose. Petiole floccose glabrescent . *pogonostylum*

GYMNANTHUM.

These are plants with thin twigs and lanceolate papyraceous leaves, usually narrow (sometimes broad, *Rh. tanastylum*) even cuneate at the base, with marginal undulation fairly distinct but only slightly roughened from fallen flocks. Wax is much developed, making the under surface somewhat glossy, and in *Rh. gymnanthum* the upper surface quite glossy Stem and petioles may be floccose and glabrescent, gland-glabrescent or gland-setose. This, except for the special development of gland-setae in *Rh. mengtszense*, is a conspicuously eglandular group—glands are absent from pedicels, calyx, ovary, and style. The flowers, white, red, or deep crimson, are in few (about 8-) flowered raceme-umbels with thin rhachis, have 5-lobed corolla, glabrous inside and out, and 10 stamens, puberulous save in *Rh. spanotrichum* and *Rh. tanastylum*. The species are absent from the Tali-Chungtien area, but range from N.W. of Tseku in the Salween basin southwards to E. Upper Burma and the Shweli-Salween divide at Tengyueh in W. Yunnan, and then turn up at Mengtsz in the S.E.

KEY TO THE SPECIES.

Leaves papyraceous (sometimes thicker), lanceolate or oblanceolate, base usually narrow and cuneate, one or both surfaces somewhat glossy, margin inconspicuously undulate and roughened; petiole floccose or gland-glabrescent or persistently gland-setose
Corolla 5-lobed, glabrous outside and in. Stamens 10. Style glabrous, rarely glandular.
Calyx glabrous flock-fringed. Corolla blotched and spotted. Petiole floccose glabrescent. Style glabrous.
Corolla white. Ovary puberulous Pedicel 1 cm. or more glabrous.
Corolla openly campanulate. Stamens pubescent Inflorescence rhachis floccose. Leaf mat above, subglossy beneath . . . *araiophyllum*

Corolla red. Ovary glabrous. Pedicel 1 cm. floccose glabrescent
Corolla funnel campanulate. Stamens puberulous. Inflorescence rhachis glabrescent. Leaf glossy above, subglossy beneath . *gymnanthum*
Corolla tubular-campanulate. Stamens glabrous. Inflorescence rhachis scurfy. Leaf mat above, subglossy beneath . . . *tanastylum*
Calyx glabrous or sparingly floccose. Corolla blotched not spotted. Petiole gland-glabrescent. Style glabrous.
Corolla red. Ovary sparingly floccose Pedicel under 1 cm. floccose.
Corolla campanulate. Stamens glabrous. Inflorescence rhachis glabrous. Leaf mat above, subglossy beneath . . . *spanotrichum*
Calyx gland-setose Corolla blotched not spotted. Petiole persistently gland-setose Style glandular.
Corolla red. Ovary gland-setose. Pedicel 2 cm. gland-setose.
Corolla openly campanulate. Stamens puberulous. Inflorescence rhachis gland-setose. Leaf mat above, somewhat glossy beneath . *mengtszense*

ANTHOSPHAERUM.

These are plants with chartaceous more or less broadly lanceolate leaves, usually dark coloured above, borne upon fairly stout twigs, and they are always floccose or floccose and glandular in parts The development of wax in *Rh. ceraceum* and *Rh. lukiangense* tends to exclude other forms of indumentum. The many red flowers on the short stout rhachis of inflorescence form a large compact truss. Whilst 5-lobed corollas and 10 stamens are constant (*Rh. ceraceum*, *Rh. lukiangense*), we find 5–6 lobes and 10–12 stamens in *Rh. anthosphaerum* and 7 lobes with 14 stamens in *Rh. hylothreptum*. This set is found only from the Likiang range northwards to Tseku and the Chungtien plateau.

KEY TO THE SPECIES.

Leaves chartaceous not rigid, more or less broadly lanceolate or oblanceolate, base obtuse, mat above, sometimes glossy beneath.
Corolla red 5 7-lobed, glabrous outside, glabrous or puberulous inside. Stamens 10 14 Style glabrous. Inflorescence rhachis floccose.
Calyx puberulous fringed Corolla without blotch or spots.
Ovary puberulous Pedicel under 1 cm. puberulous.

Corolla tubular-campanulate, 5-lobed, glabrous inside. Stamens 10, finely puberulous at base. Leaf glossy underneath. Petiole white waxy . . . . . . *ceraceum*

Calyx glabrous occasionally fringed. Corolla spotted.

Ovary glabrous. Pedicel under 1 cm., glabrous.

Corolla tubular-campanulate, 5-lobed, glabrous inside. Stamens 10, glabrous. Leaf somewhat glossy underneath. Petiole white waxy . *lukiangense*

Calyx glandular and floccose. Corolla blotched and spotted.

Ovary sparingly floccose. Pedicel 1 cm. or more glandular and floccose.

Corolla tubular-campanulate 5–6-lobed, puberulous inside. Stamens 10–12, finely puberulous at base. Leaf mat on both surfaces or somewhat glossy underneath. Petiole floccose and gland-glabrescent . . . *anthosphaerum*

Calyx glandular and puberulous, rarely gland-fringed Corolla blotched and spotted.

Ovary glabrous (at times floccose). Pedicel 1 cm. or more sparingly glandular and floccose.

Corolla widely tubular-campanulate 7-lobed, puberulous inside. Stamens 14, pubescent to middle. Leaf mat on both surfaces or somewhat glossy underneath. Petiole glandular and floccose glabrescent . *hylothreptum*

Agastum.

The two species included here are alike in foliage-form but differ in many other characters The leaves are rigid, long, narrow, oblong, and blunt, with an abrupt beak-point, the surface mat on both sides, the under-leaf punctulation very evident. One of them (*Rh. agastum*) tends to eglandular indumentum, the other (*Rh. eritimum*) to be glabrous. The large red flowers form a large compact truss, and the corolla is conspicuously 7-lobed but is sometimes only 5-lobed in *Rh. agastum*, and the stamens which ought to be and are 14 in *Rh. eritimum* are only 10–12 in *Rh. agastum*; I have not found a flower of this with 14 stamens, nor have I seen a 6-lobed corolla. One species is from the Chungtien plateau in the far N.W., the other from the Shweli-Salween divide in the W. As they stand, one can hardly speak of them as allied within the series to which they both certainly belong; they are only alike in shape of leaf. Perhaps uniting links may be found. For purposes of recognition in the series it is convenient to place them together.

KEY TO THE SPECIES.

Leaves oblong blunt with an apicular tip, surfaces mat.
Corolla red, tubular-campanulate, glabrous outside, blotched without spots.
Calyx glandular and gland-fimbriate.
Corolla 5- or 7-lobed, puberulous inside. Stamens 10 or 12. Style glandular.
Ovary glandular. Pedicel 1 cm. or more glandular. Petiole glabrescent.
Stamens 10–12, pubescent. Inflorescence rhachis floccose and glandular. Stigma discoid. Leaf with thin persistent under-leaf indumentum . *agastum*
Calyx glabrous and flock-fimbriate.
Corolla 7-lobed, glabrous inside. Stamens 14. Style glabrous.
Ovary glabrous. Pedicel under 1 cm. floccose glabrescent. Petiole glabrous.
Stamens 14, glabrous. Inflorescence rhachis floccose. Stigma not discoid. Leaf without persistent under-leaf indumentum. . *eritimum*

This Irroratum series appears to me to be a natural phylum. That the forms of it which I present here represent all its members I do not for one moment suppose.[1]

[1] In the Kew Herbarium are three sheets which the Director of Kew has kindly lent to me with others for examination. Their tickets run:—

1. Yunnan: - Mengtsz. Mountain glens. 6000–7000 ft. Flowers cream-coloured. Rare. Hancock. No. 179. 14th April 1895.
2. Yunnan:—Mengtsz. N. mountains. 8000 ft. Tree 15–20 ft. Henry. No. 10,301. [In fruit.]
3. Hort. Kew, iv, 07. No. 179/98. A. Henry.

The three plants represented are in my view of the same species, and the fact that the plant was in cultivation at Kew gives special interest to the question—What is it? The plant is now dead, the Director of Kew tells me.

Hemsley and Wilson * place Hancock's No. 179 and Henry's 10,301 in *Rh. irroratum*. They are not that species, although they belong to the Irroratum series. The cultivated plant is correctly marked by Mr. Hemsley as "aff. *irroratum*" in the Kew Herbarium. Rehder and Wilson in Plantae Wilsonianae, i (1913), 539 do not refer to these specimens. The plant represented on these sheets awaits description, but I am not to give it here because Hancock's specimen, the only native one with flowers, is not quite adequate, unless it were sacrificed to the analysis. I prefer not to use the cultivated specimen as a basis of description until evidence is forthcoming by which to test the view of identity I have stated. There is no doubt about its right to a place in the Irroratum series. It is one of the minority of the series in its possession of a style glandular throughout, and it has an axis of inflorescence about 1·5 cm. long and puberulous, pedicels glandular with a few floccose hairs, corolla puberulous inside, stamens pubescent at base and eglandular, disk apparently glabrous, ovary glandular and slightly floccose—the flocks being very scarce in the cultivated plant.

In Kew Bulletin (1910), 112.

Nor will I maintain that the limits assigned to the several species in the descriptions which I have given will not require modification when we come to know more about the plants in their living state and have for comparison with them the additional and new forms which I expect. Looking at the members of the series in the dried state, the differences between them and the characters for demarcation are easily recognised, and I believe my segregation of forms and microforms in the series is sound. As so many of the species are known at present from collection in one locality only, we may be prepared for future discoveries showing perhaps that the fluctuations in such characters as numerical symmetry of the flower and in the indumentum of the ovary, for instance, occur also in others than those in which they have been observed up till now. At the same time let us note that *Rh. irroratum*—the species which we know best, and over an area from Tali to the Chungtien plateau and Tseku—is, save for size variation in the flower, a most constant form.

Rhododendron adenostemonum, Balf. f. et W. W. Sm.[1]

Small tree reaching about 4 m. high with medium thick branches. Branches a year old pale green or dirty grey

[1] *Rhododendron adenostemonum*, Balf. f. et W.W. Sm.—Arbor parva ad 4 m. alta ramis haud crassis. Rami annotini pallide virides vel sordide grisei rubro-glandulosi vel glandularum vestigiis punctulati. Alabastra foliorum ignota. Folia petiolata ad 14 cm. longa; lamina rigide coriacea lanceolata vel oblongo-lanceolata ad 11·5 cm. longa ad 3 cm. lata apicem versus leviter attenuata acutiuscula tuberculo parvo corneo terminata margine cartilaginea obscure undulata et cicatricibus subasperata basi anguste vel late obtusa saepe inaequalis supra primo olivacea vel subglauco-viridis nunc tandem rubido-brunnea opaca laevis haud rugulosa costa media sulcata venis primariis utrinsecus circ. ad 16 vix distinctis glabrescens sed pedibus glandularum detersarum obscure punctulata subtus cinnamomea costa media venisque primariis elevatis substramineis vel suberubescentibus venularum reti rubido immerso ubique pedibus rubris glandularum detersarum punctulata; petiolus circ. 2·5 cm. longus crassus supra sulcatus glabrescens sed cicatricibus glandularum notatus. Flores circ. 12 in racemo-umbellam dispositi rhachi glandulis rubris et pilis sebaceis floccosis (?) plus minusve obtecta; bracteae fertiles oblongo-cuneatae subtruncatae subapiculatae circ. 3 cm. longae circ. 1·4 cm. latae submembranaceae brunneae extus sericeae et apice rubro-glandulosae vertice fimbriatae margine eciliatae intus basi excepta sericeae; bracteolae lineares circ. 1·4 cm. longae circ. 0·5 mm. latae pedicellos superantes spadiceae adpresso-sericeae; pedicelli crassi breves circ. 4 mm. longi dense rubro-glandulosi. Calyx minutus circ. 2·75 mm. longus cupularis cupula extus sparse glandulosa 5-lobatus, lobis carnosulis late triangularibus vel ovatis dorso puberulis et sparsissime glandu-

glandular with red glands or punctulate with gland-vestiges. Foliage buds unknown. Leaves petiolate as much as 14 cm. long; lamina rigid coriaceous thickish lanceolate or oblong-lanceolate as much as 11·5 cm. long by 3 cm. broad slightly attenuated towards the apex and somewhat acute terminated by a small horny tubercle, margin cartilaginous slightly undulate and somewhat roughened by the cicatrices of fallen appendages, base narrowly or broadly obtuse often unequal; upper surface at first olivaceous or sometimes glaucous green frequently becoming reddish-brown mat smooth not rugulose, midrib grooved primary veins about 16 pairs scarcely distinct, whole surface glabrescent but obscurely punctulate with the bases of glands (or hairs ?) which have fallen; under surface cinnamon-coloured with the midrib and primary veins raised somewhat straw-coloured or somewhat reddening, network of the veinlets dark red immersed surface everywhere punctulate with the red bases of glands (or hairs ?) which have fallen, petiole about 2·5 cm. long thick grooved above glabrescent but marked by the cicatrices of glands. Flowers about 12 in a raceme-umbel the axis of inflorescence covered with red glands and perhaps with greasy floccose hairs; fertile bracts oblong wedge-shaped somewhat truncate and apiculate about 3 cm. long by 1·4 cm. broad submembranaceous brownish, outside sericeous and red-glandular at the fimbriate apex, margin

losis glandulis breviter stipitatis margine nunc glanduloso-ciliatis. Corolla alba vel leviter roseo-suffusa infundibuliformi-campanulata circ. 4·5 cm. longa extus eglandulosa epilosa intus copiose puberula postice evariculata maculis paucis notata 5-lobata, lobis ellipticis vel rotundatis nunc emarginatis subcrenulatis circ. 1·8 cm. longis circ. 2·5 cm. latis. Stamina 10 inaequalia longiora circ. 3·5 cm. longa breviora circ. 2·5 cm. antheris purpureis circ. 3·5 mm. longis, filamentis aurantiacis basi paullo expansis ab ima basi ad medium vel ultro saepe fere ad apicem tenuiter pubescentibus et rubro- vel aurantiaco glandulosis. Discus pilis albis pubescens. Gynaeceum circ. 4·3 cm. longum; ovarium conoideum sulcatum circ. 6 mm. longum fulvo-olivaceum vel nigricans glandulis rubris brevistipitatis ex toto obtectum et pilis sebaceis floccosis rubris (ramulis acutissimis) in dimidio infero nunc fere ex toto praeditum; stylus gracilis ex toto rubro-glandulosus sub stigmate spongioso subdiscoideo leviter ampliatus.

Species *Rh. irrorato*, Franch. affinis, pedicello brevi haud 1 cm. longo, calyce extus puberulo, corolla infundibuliformi-campanulata extus eglandulosa, staminum filamentis ad medium vel ultro tenuiter puberulis et glandulosis, disco pubescente, ovario partim flocoso, stigmate subdiscoideo diversa.

eciliate, inside sericeous except at the base; bracteoles linear about 1·4 cm. long and 0·5 mm. broad longer than the pedicels chestnut-brown adpressed-sericeous; pedicels thick short about 4 mm. long densely red-glandular. Calyx minute about 2·75 mm. long cupular, cup sparingly glandular outside, 5-lobed; lobes fleshy broadly triangular or ovate puberulous on the back and most sparingly glandular with shortly stalked glands, margin occasionally gland-ciliate. Corolla white or slightly suffused with rose funnel-campanulate about 4·5 cm. long outside eglandular and epilose inside copiously puberulous and on the posterior side evariculate but with a few spots, 5-lobed; lobes about 1·8 cm. long by 2·5 cm. broad, elliptic or rounded occasionally emarginate and subcrenulate. Stamens 10 unequal the longer about 3·5 cm. long the shorter about 2·5 cm.; anthers purple about 3·5 mm. long; filaments orange slightly expanded at the base and from the very bottom up to the middle and beyond it (often even to the apex) pubescent and provided with red or orange glands. Disk pubescent with white hairs. Gynaeceum about 4·3 cm. long, ovary conoid grooved about 6 mm. long tawny olive or sometimes blackening covered with red shortly stalked glands throughout and in the lower half provided with greasy floccose red hairs with very sharp-pointed branches, occasionally these extend to near the top; style slender red-glandular throughout slightly ex panded under the spongy somewhat discoid stigma.

S E. Yunnan:—Mengtsz. N. mountains, forests. 7000 ft Tree 15 ft. Flowers pure white. Henry. No. 11 067 In Herb. Kew.

S.E. Yunnan:—Mengtsz. N. mountains, forests. 8500 ft Tree 10 ft. Flowers white with a little pink. Henry No 11,067A. In Herb. Edin.

This is one of the plants of Henry's collecting from the region of Mengtsz, and was referred by Hemsley and Wilson[1] to *Rh. irroratum*. Subsequently Rehder and Wilson[2] suggested that it might, with others of Henry's collecting about Mengtsz, be a variety of *Rh. gymnanthum* (see under *Rh. mengtszense* and *Rh. spanotrichum* in this paper). It certainly finds its place in the Irroratum series

[1] Kew Bulletin (1910), 12. [2] Plantae Wilsonianae, i (1913), 539.

along with *Rh. gymnanthum* and *Rh. irroratum*, and it is a very near ally of *Rh. irroratum* itself. Glandular stems, petioles, pedicels, and styles belong to both species; the points of difference between them are these:—The inflorescence rhachis has apparently (but see p. 164) floccose and adpressed hairs with glands, in *Rh. irroratum* glands only are present; the flower in *Rh. adenostemonum* has pedicels seldom over 1 cm. long; those of *Rh. irroratum* are over 1 cm. long; the calyx in *Rh. adenostemonum* has the cup sparingly glandular and the back of the lobes more or less puberulous, with a few stray glands particularly at the base and now and then one in the margin; in *Rh. irroratum* the calyx-cup is densely glandular and the lobes gland-fringed, there are no hairs; the corolla and stamens show a curious antithesis in character—*Rh. adenostemonum* has a funnel-shaped corolla, glabrous, quite eglandular on the outside and densely pubescent inside, and the staminal filaments are conspicuously puberulous to the middle and beyond it, and show in addition a remarkable development of small, red, shortly-stalked glands, in some cases up to near the base of the anther (hence its specific name); *Rh. irroratum* has a tubular-campanulate corolla which has a development of small, short-stalked, red glands on the outside, particularly along the midribs of the petals, inside it is densely puberulous and the stamens are finely puberulous at the base only, and have no glands, then the disk in *Rh. adenostemonum* is pubescent, in *Rh. irroratum* glabrous, and the ovary, glandular in both, has in *Rh. adenostemonum* floccose hairs as well all over or at the base only. The characters I have mentioned seem to be constant in *Rh. irroratum* in a large series of specimens I have examined from different areas of its wide distribution, from Tali to the Chung-tien plateau. Of *Rh. adenostemonum* I have only seen specimens from one locality, one sheet of them, No. 11,067 in the Kew Herbarium, kindly lent to me by the Director of Kew, and one sheet, No. 11,067A in the Edinburgh Herbarium. The sum of the differential characters, fluctuating though some of them may be in other species, is to me conclusive against conspecificness of the two plants. Of individual characters, that of the gland development on

the filaments—a rare feature—in one, and gland development on corolla in the other, is of weight. Taking further into consideration the fact that Henry's plant (*Rh. adenostemonum*) is a plant of the extreme south-east of Yunnan, in the basin of the Red River, somewhere about latitude 23° 25′ N., and dwells at an altitude of 8500 feet, whilst *Rh. irroratum* is a Middle-West and East-North-West Yunnan plant essentially of the Yangtze basin, at its lowest latitude—25° 40′ N., on the Tali range—living at an altitude of 11,000–12,000 feet at its highest latitude, 27° 30′ N., on the Chungtien plateau, at 9000–10,000 feet, I do not hesitate about regarding them as distinct species.

With *Rh. gymnanthum* our species has much less in common. *Rh. gymnanthum* is a red-flowered species with very narrow leaves, glossy above, with eglandular floccose stems, petioles, inflorescence rhachis, pedicels, and a glabrous style, glabrous fringed calyx, the fringe lobes sometimes gland-tipped, corolla glabrous inside and out, staminal filaments eglandular and most sparingly puberulous near base, disk glabrous, ovary glabrous.

Rhododendron agastum, Balf. f. et W. W. Sm.[1]

Shrub as much as 6 m. high with thick branches. Young branches of the year more or less clad with clavate

[1] *Rhododendron agastum*, Balf. f. et W. W. Sm.—Frutex ad 6 m. altus ramis crassis. Ramuli hornotini glandulis clavatis plus minusve vestiti annotini pallide virides glabrescentes pilorum juvenilium vestigiis plus minusve notati. Alabastrorum perulae intimae membranaceae flavido-brunneae ligulato-spathulatae circ. 2·5 cm. longae circ. 4 mm. latae viscidae extus glandulis clavatis plus minusve indutae intusque pilis floccosis sebaceis vestitae ad apicem acuminatum pilo-cristatae; folia juvenilia revoluta supra pilis floccosis multiramosis tomentosa subtus pilis plurimis brevissime stipitatis copiose radiatim ramulosis ramulis patentibus laxe reticulatim intertextis induta; petiolus juvenilis tomentosus. Folia petiolata ad 14 cm. longa; lamina coriacea crassa stricte oblonga nunc supra medium paullo latior circ ad 12 cm longa ad 4 cm. lata haud attenuata apice obtusa corneo-mucronata margine subplana cartilaginea obscure undulata et pilorum juvenilium pedibus vel pilis ipsis paucis praedita basi late obtusa supra opaca olivacea laevis costa media sulcata venis primariis utrinsecus ad 15 occultis glabrescens nunc pilorum juvenilium vestigiis obscure notata subtus fulvo-olivacea minutissime rufo-punctulata costa media straminea elevata plus minusve glandularum pilorumque vestigiis praedita venis primariis venularumque reti prominulo cum superficie ubique indumento tenui subfurfuraceo e pilis multo-brachiatis (ramulis ab umbone sessili rubro radiatim patentibus) composito vestitis; petiolus ad 2 cm. longus crassus glabrescens supra sulcatus pilorum vestigiis plus minusve praeditus. Flores ad 20 racemoso-

glands; branches a year old, pale green glabrescent marked more or less by the vestiges of juvenile hairs (or glands?). Innermost scale-leaves of the foliage-buds membranaceous yellow-brown ligulate spathulate about 2·5 cm. long by 4 mm. broad viscid clad outside more or less with clavate glands, inside with floccose greasy hairs and a hair crest at the acuminate apex; juvenile leaves revolute upper surface tomentose with much-branched floccose hairs, under surface clad with very many shortly-stalked hairs abundantly and radiatingly branched, the branches spreading out laterally and becoming loosely interwoven, juvenile petiole tomentose. Leaves petiolate as much as 14 cm. long, lamina coriaceous somewhat thick truly oblong, occasionally slightly wider above the middle, about 12 cm. long by 4 cm. broad not attenuated at the apex but obtuse terminated by a horny mucro, margin somewhat flat cartilaginous obscurely undulate and showing the bases of juvenile hairs or even a few hairs themselves, base broadly obtuse, upper surface mat olivaceous smooth with a grooved midrib primary veins about 15 pairs hidden the whole surface glabrescent but occasionally obscurely marked by the vestiges of juvenile hairs; under surface tawny olivaceous most minutely red-punctulate, midrib

umbellati rhachi ad 2 cm. longa glandulis et pilis sebaceis induta; bracteae fertiles circ. 3 cm. longae circ 1·3 cm. latae submembranaceae oblongo-obovatae vel obovato-spathulatae apiculatae intus extusque albido-sericeae glandulis paucis intermixtis; bracteolae lineares ramentaceae adpresso-pilosae circ. 1 cm. longae; pedicelli circ. 1·2 cm. longi fusco-brunnei dense clavato-glandulosi. Calyx parvus circ. 3 mm. longus cupularis extus dense glandulosus, lobis 7 distinctis rotundatis vel ovatis vel deltoideis glandulosis et glanduloso-fimbriatis. Corolla rosea postice emaculata sed varo basali magno kermesino praedita tubuloso-campanulata magna circ. 5 cm. longa gynaeceum et stamina superans extus glabra eglandulosa intus copiose puberula, lobis 5-7 rotundatis emarginatis subcrenulatis circ. ad 2 cm. longis ad 2·4 cm. latis. Stamina 10–12 inaequalia longiora circ. 3·8 cm. longa breviora circ. 2·7 cm. longa antheris brunneis circ. 4 mm. longis, filamentis deorsum latioribus a basi ad apicem ovarii pubescentibus. Discus sebaceo-floccosus. Gynaeceum circ. 1·5 cm. longum, ovarium cylindrico-conoideum sulcatum circ. 6 mm. longum circ. 3·5 mm. diam. nigrescens clavato-glandulosum ad basim nunc pilis sebaceis paucis indutum; stylus crassus ex toto glandulosus; stigma magnum latum discoideum lobulatum.

Species ex affinitate *Rh. anthosphaeri*, Diels sed foliis oblongis ad extremitates haud attenuatis, subtus indumento indutis, corolla emaculata 5-7-lobata, staminum filamentis ad basim pubescentibus haud brevissime puberulis, disco floccoso, ovario clavato-glanduloso, stylo glanduloso, stigmate lato discoideo facile distinguenda.

straw-coloured and more or less raised provided with vestiges of glands and hairs, primary veins and the reticulation of the veinlets somewhat prominent, the whole surface clad with a thin somewhat scurfy stratum of indumentum consisting of many-armed hairs with red branches radiating and spreading from a sessile umbo, petiole thick as much as 2 cm. long glabrescent grooved above and showing more or less vestiges of hairs. Flowers in a racemose umbel about 20-flowered the axis of inflorescence about 2 cm. long and covered with glands and greasy hairs; fertile bracts about 3 cm. long by 1·3 cm. broad submembranaceous oblong-obovate or obovate-spathulate apiculate whitely sericeous both outside and inside with a few glands intermixed, bracteoles linear chaffy adpressed-pilose about 1 cm. long; pedicels about 1·2 cm. long reddish-brown and densely clavate-glandular. Calyx small about 3 mm. long cupular, outside densely glandular 7-lobed; lobes rounded or ovate or deltoid glandular and gland-fimbriate. Corolla rose-coloured emaculate on the back but with a large basal crimson blotch tubular-campanulate large about 5 cm. long exceeding the stamens and gynaeceum, outside glabrous eglandular, inside copiously puberulous, lobes 5-7 rounded emarginate somewhat crenulate about 2 cm. long by 2·4 cm. broad. Stamens 10–12 unequal longer about 3·8 cm. long, shorter about 2·7 cm. long; anthers brown about 4 mm. long; filaments widening downwards and from their base to the apex of the ovary pubescent. Disk greasily floccose. Gynaeceum about 4·5 cm. long; ovary cylindric-conoid grooved about 6 mm. long by 3·5 mm. in diameter blackening clavate-glandular occasionally coated at the base with a few greasy hairs; style thick glandular throughout; stigma large broad discoid lobulate.

W. Yunnan:—Head of the Taipungpu valley. Alt. 7000–8000 ft. Lat. 25° 30′ N. In oak and pine forest. Shrub of 10–15 ft. Flowers rose. G. Forrest. No. 9920. May 1913.

W. Yunnan:—Descent to the Yangpi valley. Alt. 9000 ft. Lat. 25° 40′ N. Margins of forests. Shrub of 30 ft. Flowers deep rose, without markings. G. Forrest. No. 12,389. April 1914.

This striking species is one of two (the other *Rh. eritimum*) within the Irroratum series in which the leaves are truly oblong with a somewhat beaked apex. It is also the only species in the series in which the juvenile indumentum of the under side of the leaf persists, forming here a thin veil over the reticulate venulose surface. Another conspicuous character in which it is alone in the Irroratum series is its large discoid stigma. The numerical symmetry of the flower seems to be variable. In the specimen No. 9920 the corolla is 5-lobed and there are 10 stamens. In No. 12,389 the corolla is 7-lobed and there are 12 stamens. The majority of species in the series are 5-lobed in the corolla and diplostemonous; two species (*Rh. eritimum* and *Rh. hylothreptum*) have 7-lobed corollas and are diplostemonous. *Rh. anthosphaerum* has a 5–6-lobed corolla and 10–12 stamens. The numbers counted in *Rh. agastum* seem to suggest that one may expect a 5-, 6- or 7-lobed corolla and 10–14 stamens. The settlement of this question, which involves the diagnostic value of numerical symmetry in the series, will, I hope, be achieved by Mr. Forrest during the further exploration of Yunnan, which he is undertaking.

Rhododendron anthosphaerum, Diels in Notes R.B.G. Edin., v (1912), 215.[1]

Shrub or small tree as much as 9 meters high. Branches stout, those a year old blackish-grey densely clad with

[1] The description by Diels runs :—

Rhododendron anthosphaerum, Diels. Frutex vel arbor 6–9 m. alta. Folia petiolo glabro 1·5 cm. longo praedita ; papyracea, supra glabra, subtus rufescenti-pallidiora, oblanceolata, acuta, 8–13 cm. longa, 2·5–5·2 cm. lata, nervi subtus inconspicui. Flores 10-15 dense congesti, pedunculi 7–12 mm. longi, pubescentes Calycis minuti lobi inconspicui triangulares, glandulosi, vix 1 mm. longi. Corolla intense rosea atro-purpureo-maculata, campanulata ; tubus 2·5-3·5 cm. longus 3·2–4 cm. latus ; lobi rotundati 1·5–2 cm. diamet. Stamina 10 basim versus minute puberula, 3–3·5 cm. longa. Ovarium glabrescens, 5-8 mm. longum ; stylus 3–3·5 cm. longus, praeter basim puberulam glaber.

"Shrub or tree of 20–30 ft. Flowers bright rose-magenta, with a few markings of black-crimson. Open situations in pine forests on the ascent to the Sungkwei pass from the Langkiung valley. Lat. 26° 30′ N. Alt. 10,000–11,000 ft. April 1906." G. Forrest. No. 2042.

Habit of *R. irroratum*, Franch. but easily recognised by the colour of the flowers and the more glabrous ovary and the absence of glands on the style.

rufous clavate glands mixed with flocci of greasy hairs; older branches with vestiges of these. Foliage buds and young leaves unknown. Leaves petiolate as much as 14 cm. long; lamina papyraceous broadly lanceolate rarely (if small) somewhat oblanceolate as much as 12 cm. long and 5 cm. broad always narrowed to both ends, apex acute with a horny blunt mucro, margin cartilaginous flat obscurely undulate and roughened (hardly notched) by the persistent bases of juvenile greasy hairs, occasionally some hairs persist, base obtuse, upper surface opaque bronze-green midrib and primary veins (about 18 pairs) slightly sulcate elsewhere the irregular network of the ultimate veins shows clearly in the dried leaf (I expect invisible in the fresh) whole surface apparently glabrous but slight vestiges of juvenile hairs are present; under surface mat fawn-coloured midrib prominent straw-coloured (as are the primary veins only less prominently so) more or less sprinkled with withered and withering floccose hairs and also with orange-coloured bases of fallen flocks and glands, such bases are abundant over the rest of the surface but do not show up markedly as distinct punctulations the epidermal cells form low dome shaped papillae, the fawn colour of the whole under surface is due to the coloration of the reticulate venation, petiole as much as 2 cm long stout grooved above, marked by scars of fallen glands and hairs which may sporadically persist. Flowers about 12 in a terminal racemose-umbel with very short red brown floccose rhachis not 1 cm. long, bracts unknown; bracteoles about 1 mm. long very narrowly linear reddish sericeo-pilose, pedicels as much as 1·3 cm. long pale brown fairly densely coated with a mixture of floccose and simple sebaceous hairs and a few clavate glands Calyx minute cupular fleshy clavate-glandular floccosely and greasily pilose outside, about 1·5 mm. long, lobes more or less deltoid. Corolla tubular-campanulate 5–6-lobed, bright rose-magenta with a posterior basal black-crimson blotch and a few like-coloured spots about 4·5 cm. long exceeding androecium and gynaeceum, glabrous outside puberulous inside; lobes about 2 cm. long and 2·5 cm. broad rounded emarginate somewhat crenulate. Stamens 10–12 unequal, longest some 3·3 cm. long shortest 2·3 cm., anthers about 3 mm. long purple;

filaments widened at base and from there finely puberulous to above ovary. Disk most glabrous. Gynaeceum about 4 cm. long shorter than corolla; ovary about 6 mm. long conoid furrowed blackening sparingly coated with flocks of greasy hairs or single greasy hairs or with cauliflower glands; style glabrous throughout slightly clavately expanding into lobulate non-discoid stigma.

Mr. Forrest obtained this in only one locality, that of the Sungkwei pass (East-North-West Yunnan), a station in which *Rh. irroratum*, Franch.—with which it has affinity, as Diels points out,—also occurs. *Rh. anthosphaerum* cannot be mistaken for *Rh. irroratum*. It wants the glaucous foliage of that species and has bright red flowers. The mature leaves are papery in texture, not rigid, thick, coriaceous as in *Rh. irroratum*; they are longer and broader, and the midrib below has more or fewer greasy hairs persisting upon it. The inflorescence rhachis is shorter and is floccosely pubescent not glandular as in *Rh. irroratum*, and the same indumental difference appears in the pedicels. There are never glands on the outside of the corolla. Then we have the interesting fact in *Rh. anthosphaerum* that the corolla lobes vary from 5 to 6, and there is a corresponding fluctuation in the stamens from 10 to 12. I have not found a 7-lobed corolla nor 14 stamens. *Rh. irroratum* seems to be a form with a strictly 5-lobed corolla. No fluctuation in size of corolla and flower parts generally appears in *Rh. anthosphaerum*. The filaments here are finely puberulous from the very base upwards to just above the ovary, as in *Rh. irroratum*. The gynaeceum offers distinctive characters. The blackening ovary has the glands of *Rh. irroratum* replaced by greasy floccose or single hairs, and instead of being glandular the style of *Rh. anthosphaerum* is glabrous throughout, the stigma not discoid. Diels refers to a puberulous base of the style. This only refers to the fact that there is occasionally a slight extension of the flocks of the ovary upon the lowermost part of the style, but one cannot rightly speak of the style as being puberulous at base (see also p. 168).

More near is the relationship with *Rh. hylothreptum*, Balf. f. et W. W. Sm., also from the Sungkwei pass.

Rhododendron araiophyllum, Balf. f. et W. W. Sm.[1]

Slender branched shrub as much as 5 m. high. Branches a year old reddening more or less white floccose glabrescent and glossy, after some years (4–5) grey and decorticating. Outermost scale-leaves of the foliage-leaf buds—which are

[1] *Rhododendron araiophyllum*, Balf. f. et W. W. Sm. — Frutex tenuiramosus ad 5 m. altus. Ramuli annotini erubescentes plus minusve albido-floccosi glabrescentes et nitidi post annos 4–5 grisei decorticantes. Alabastrorum anguste ovoideorum acutorum circ. 4 mm. diam. perulae extimae crustaceo-coriaceae fulvae circ. 8 mm. longae infra rotundatae circ. 3 mm. longae et latae supra in caudam circ. 5 mm. prolongatae extus eglandulosae plus minusve sebaceo-floccosae, intermediae longiores et latiores ecaudatae mucronatae subovatae, intimae convolutae membranaceae flavido-brunneae ad 2·7 cm. longae circ. 4 mm. latae acutae saepe mucronulatae dorso apiceque margineque sebaceo-floccosae intus glabrae ad apicem sericeae; folia juvenilia revoluta supra et costa media subtus pilis floccosis longi- et multi-ramosis saepe sebaceis rufo-coloratis intricatim intertextis densissime tomentosa superficie inferiore glaberrima; petiolus juvenilis sebaceo-tomentosus. Folia petiolata ad 12·5 cm. longa; lamina chartacea lanceolata ad 11·5 cm. longa ad 3 cm. lata apice subacuminata tuberculo corneo terminata margine subplana obscure undulato-crenulata pilorum juvenilium detersilium vestigiis notata basi cuneata supra brunneo-olivacea opaca costa media sulcata venis primariis utrinsecus circ. 15 inconspicuis laevis glabra sed floccorum juvenilium vestigiis nunc notata, subtus pallidior saepe fulva subnitens costa media erubescente et venis primariis elevatis glabrescentibus punctulatis vel floccorum juvenilium vestigiis praeditis vel pilis sebaceis dense floccoso-tomentosis caeteroquin glabra epunctulata venularum reti paullo conspicuo epidermide epapillata; petiolus circ. 1 cm. longus rubidus subcrassus subglabrescens floccorum vestigiis notatus. Flores circ. 8 (nunc pauciores) racemoso-umbellati rhachi tenui ad 1·5 cm. longa pilis floccosis intertextis plus minusve vestita; bracteae deciduae ignotae; bracteolae rufescentes angustissime ligulatae ad 1·2 cm. longae sericeo-pilosae, pedicelli graciles rubro-brunnei glaberrimi nunc pilis floccosis paucissimis praediti circ. 1·5 cm. longi. Calyx minutus cupularis carnosulus circ. 1·5 mm. longus cupula glaberrima 5-lobatus, lobis semi-lunatis vel ovato-truncatis extus glaberrimis margine pilis albidis vel rubris sebaceis simplicibus vel floccosis ciliatis. Corolla alba extus roseo-suffusa brevis aperte campanulata circ. 3·5 cm. longa genitalia superans 5-gibbosa retusa extus eglandulosa epilosa intus glabra et postice varo magno basali kermesino supraque maculis paucis notata 5-lobata, lobis circ. 1·4 cm. longis circ. 2 cm. latis rotundatis emarginatis subcrenulatis. Stamina 10 inaequalia longiora circ. 2 8 cm. longa breviora circ. 1·4 cm. longa antheris rubris circ. 3·5 mm. longis, filamentis basi paullo latioribus et ab ima basi ad apicem ovarii dense pubescentibus. Discus glaber. Gynaeceum circ. 2·8 cm. longum stamina longiora subaequans; ovarium intense brunneum vel nigrescens papillatum conoideum sulcatum circ. 5·5 mm. longum brevissime albido-puberulum pilis subadpressis; stylus ruber glaber in stigma purpureum lobulatum paullo ampliatus.

Species *Rh. tanastylo*, Balf. f. et Ward q.v. proxima; *Rh. gymnantho*, Diels etiam affinis foliis brevioribus supra haud nitentibus nunc subtus tomento persistente indutis, floribus minoribus, pedicello glabro, corolla alba roseo-suffusa aperte campanulata, staminum filamentis dense pubescentibus, ovario minore puberulo distinguenda.

narrowly ovoid acute and about 4 mm. in diameter—crustaceo-coriaceous tawny about 8 mm. long, the lower part rounded sheathing about 3 mm. long and broad prolonged upwards into a tail of about 5 mm. long, outside eglandular more or less greasily floccose, intermediate scale-leaves longer and broader without tails but mucronate somewhat ovate, innermost scale-leaves convolute membranaceous yellow-brown as much as 2·7 cm. long and 4 mm. broad acute often mucronulate, greasily floccose on the back at the apex and on the margin, glabrous inside except at the sericeous apex; juvenile leaves revolute the upper surface and the midrib of the lower surface very densely tomentose with long many-branched floccose hairs which are often greasy rufously coloured and are intricately interwoven, rest of the lower surface very glabrous; juvenile petiole greasily tomentose. Leaves petiolate as much as 12·5 cm. long; lamina papery lanceolate as much as 11·5 cm. long and 3 cm. broad somewhat acuminate at the apex where is a terminal horny tubercle, margin somewhat flat obscurely undulate crenulate and marked by the vestiges of juvenile fallen hairs, base cuneate; upper surface brown-olive coloured mat the midrib grooved the primary veins as many as 15 pairs inconspicuous, the whole surface smooth and glabrous but marked occasionally by the vestiges of juvenile flocks; under surface paler often tawny somewhat glossy, midrib reddening and with the primary veins elevated glabrescent punctulate or marked by the vestiges of fallen flocks or somewhat densely floccose tomentose with greasy hairs, the whole surface elsewhere glabrous epunctulate, the reticulation of the veinlets slightly conspicuous, the epidermis epapillate; petiole about 1 cm. long red somewhat thick somewhat glabrescent marked by vestiges of juvenile flocks. Flowers as many as eight (even fewer) in a racemose-umbel with a slender axis as much as 1·5 cm. long and more or less clad with floccose intertwined hairs; bracts deciduous unknown; bracteoles rufescent very narrowly ligulate as much as 1·2 cm. long and silkily pilose; pedicels about 1·5 cm. long, slender reddish-brown very glabrous but occasionally provided with a few floccose hairs. Calyx minute cupular fleshy about 1·5 mm. long, cup very glabrous, 5-lobed; lobes semi-

lunate or ovate truncate outside very glabrous margin ciliate with white or red hairs sometimes simple sometimes floccose. Corolla white suffused outside with rose, short openly campanulate about 3·5 cm. long exceeding the stamens and gynaeceum, 5-gibbous at the base and retuse, outside eglandular and without hairs, inside glabrous and marked on the back by a large basal crimson blotch with a few spots above it, 5-lobed; lobes about 1·4 cm. long and 2 cm. broad rounded emarginate and subcrenulate. Stamens 10 unequal, the longer about 2·8 cm. long the shorter about 1·4 cm. long; anthers red about 3·5 mm. long; filaments slightly wider towards the base and from the very base to the apex of the ovary densely pubescent. Disk glabrous. Gynaeceum about 2·8 cm. long nearly equalling the longer stamens, ovary intensely brown or blackening papillate conoid grooved about 5·5 mm. long, clad with very short somewhat adpressed white hairs; style red glabrous slightly expanding into the purple lobulate stigma.

W. Yunnan. Shweli-Salween divide. Alt. 9000-10,000 ft. In mixed forests and thickets. Shrub of 9–16 ft. Flowers white flushed exterior rose-lavender. G. Forrest. No. 11,918. June 1913.

This is, I think, one of the most charming species of the Irroratum series. Its flowers are described as white flushed rose-lavender on the outside. It is one of the three white-flowered species of the Irroratum series, the others being *Rh. adenostemonum* and *Rh. irroratum*—which are, however, very different plants, particularly in the development of glands. Our species has delicate graceful branches with narrow willow-like leaves, and the flower-trusses if not large are composed of flowers with delicate pedicels and beautifully shaped open campanulate corolla. It may perhaps be regarded as not far removed from *Rh. gymnanthum* in the series, but has smaller leaves which are not polished on upper surface, smaller flowers, a campanulate not funnel-shaped corolla, glabrous pedicels, pubescent not sparingly puberulous filaments to the stamens and a puberulous ovary. Its nearest ally is without doubt an equally pretty species, *Rh. tanastylum*, Balf. f. et Ward, from over the frontier in E. Upper Burma. This may be spoken of as a crimson-flowered *Rh. araiophyllum*, for in

vegetation, habit, and inflorescence the two plants are much alike; but in the Burmese plants the pedicels are shorter, the corolla tubular-campanulate and larger, the staminal filaments are glabrous, as is the ovary, whilst the style is ever so much longer than the stamens.

Not infrequently the leaf under-side retains its juvenile indumentum on the midrib as a floccose tomentum.

Rhododendron ceraceum, Balf. f. et W. W. Sm.[1]

Shrub with medium thick branches. Branchlets a year old as much as 4 mm. in diameter pale green covered

[1] *Rhododendron ceraceum*, Balf. f. et W. W. Sm.—Frutex ramis haud crassis. Ramuli annotini ad 4 mm. diam. pallide virides strati superficialis albi ceracei desquamantis vestigiis plus minusve notati. Alabastra et folia juvenilia ignota. Folia petiolata ad 13 cm. longa; lamina chartacea late lanceolata vel ovali-lanceolata vel sub-oblonga a medio utrinque attenuata nunc oblanceolata ad 11·5 cm longa ad 4 cm. lata apice abrupte acuta subrostrata corneo-tuberculata margine plana vel paullo recurvata cartilaginea obscure undulata (et pilorum juvenilium pedibus minutissimis notata) basi obtusa supra olivacea subnitens glaberrima fere epunctulata costa media erubescente sulcata venis primariis utrinsecus circ. 16 vix conspicuis caeteroquin laevis vel obscure reticulata (lamina in vicinitate venarum primarum nunc erubescente) subtus fulvo-viridis glaberrima costa media venisque primariis erubescentibus elevatis venularum reti rubido vel fulvo nitens laevis cerivernicosa epiderinide epapillata; petiolus crassus corrugatus circ. 1·5 cm. longus supra sulcatus cerae strato albo desquamante notatus. Flores inflorescentiae cujusque circ. 10 racemoso-umbellati rhachi circ. 1·5 cm. longa pilis albis floccosis adpressis dense tomentosa; bracteae fertiles oblongae vel obovato-spathulatae ad 2·8 cm. longae ad 1 cm. latae membranaceae flavido-brunneae ciliatae extus dense sericeae intus prope apicem centro sericeae; bracteolae delicatissimae filiformes adpresso-pilosae circ. 1 cm. longae: pedicelli vix 1 cm. longi brunnei sparsim et minute puberuli. Calyx cupularis minutus circ. 1·5 mm. longus extus sparsim puberulus, lobis nunc deltoideis nunc late semi-lunatis nunc rotundatis minutissime fimbriatis. Corolla rosea(?) tubuloso-campanulata circ. 3·7 cm. longa androecium et gynaeceum superans extus intusque glabra emaculata evariculata, lobis 5 subaequalibus circ. 1·5 cm. longis circ. 2 cm. latis rotundatis emarginatis vel retusis plus minusve crenulatis. Stamina 10 inaequalia longiora circ. 3·3 cm. longa breviora circ. 2 cm. longa antheris atro-purpureis circ. 3·25 mm. longis in staminibus longioribus circ. 2 mm. in brevioribus, filamentis complanatis basi vix latioribus ibique minutissime puberulis eglandulosis. Discus pubescens. Gynaeceum circ. 3·5 cm. longum stamina paullo superans corolla brevior; ovarium atro-purpureum leviter sulcatum angustum cylindricum circ. 6 mm. longum 2 mm. diam. sparsim puberulum (saepe solum infra medium) rarissime hic et illic glandula singula praeditum; stylus glaber sub stigmate lobulato paullo clavatim expansus.

Species *Rh. anthosphaero*, Diels affinis sed eglandulosa et foliis cerivernicosis, ramulis petiolisque ceraceo-desquamantibus, inflorescentiae rhachi dense sericeo-floccoso-tomentosa, pedicello brevi haud 1 cm. longo puberulo, calyce puberulo fimbriato, corolla minore intus glabra, disco

with a surface stratum of white desquamating wax or its vestiges. Foliage-leaf buds and juvenile leaves unknown. Leaves petiolate as much as 13 cm. long; lamina chartaceous broadly lanceolate or somewhat oblong or oval-lanceolate, occasionally oblanceolate as much as 11·5 cm. long and 4 cm. broad apex abruptly acute somewhat beaked ending in a horny tubercle, margin flat or slightly recurved cartilaginous obscurely undulate and minutely marked by the bases of fallen juvenile hairs, base obtuse; upper surface olivaceous somewhat glossy almost epunctulate very glabrous, the often reddening midrib grooved, primary veins about 16 pairs hardly conspicuous, elsewhere smooth or obscurely reticulate (in older leaves a tendency to reddening of surface about the primary veins); under surface tawny green very glabrous with the often reddening midrib and primary veins elevated the network of the ultimate veins red or tawny, the whole surface glossy smooth wax-varnished almost epunctulate with an epapillate epidermis; petiole thick wrinkled about 1·5 cm. long grooved above clad with a desquamating white stratum of wax. Flowers of the inflorescence about 10, racemosely umbellate the axis of inflorescence about 1·5 cm. long densely tomentose with white floccose adpressed hairs; fertile bracts oblong or obovate-spathulate as much as 2·8 cm. long and 1 cm. broad membranaceous yellow-brown ciliate, outside densely silky, inside near apex in the middle silky; bracteoles most delicately filiform adpressed-pilose about 1 cm. long; pedicels scarcely 1 cm. long brown sparsely and minutely puberulous. Calyx cupular minute about 1·5 mm. long outside sparsely puberulous; lobes deltoid sometimes broadly semi-lunate sometimes rounded most minutely fimbriate. Corolla rose-coloured (?) tubular-campanulate about 3·7 cm. long exceeding the stamens and gynaeceum outside and inside glabrous without blotch or spots, 5-lobed, lobes nearly equal about 1·5 cm. long and 2 cm. broad rounded emarginate or retuse more or less crenulate. Stamens 10 unequal, longer about 3·3 cm. long shorter about 2 cm. long; anthers dark purple

pubescente, ovario puberulo valde diversa; a *Rh. lukiangensi*, Franch foliis brevioribus et latioribus apice haud rostratis laete nitentibus, pedicellis cum calyce staminumque filamentis ovarioque puberulis, corollae minoris lobis subaequalibus postice maculatis recedens.

about 3·25 mm. long in longer stamens about 2 mm. in shorter; filaments flattened at the base scarcely widened and there most minutely puberulous eglandular. Disk pubescent. Gynaeceum about 3·5 cm. long slightly exceeding the stamens but not the corolla; ovary black-purple slightly grooved narrow cylindric about 6 mm. long by 2 mm. in diameter and most sparingly puberulous (often below the middle only) very rarely bearing here and there a single gland; style glabrous slightly shorter than corolla and slightly clavately expanded under the lobulate stigma.

W.N.W. Yunnan. Tseku. Monbeig. No. 166. Herb. Edin. 1907.

A remarkable species, which we know only in specimens collected by Père Monbeig, and of which the precise locality is not recorded. The specimens were received at Edinburgh in 1907 when Père Monbeig was residing at Tseku, and Mr. Forrest, to whose kind intervention we are indebted for them, tells me that Père Monbeig's collections at that time were made mainly to the N.W. of Tseku, and this plant may therefore come from across the Tibeto-Yunnan frontier. I hope Mr. Forrest may find during his next exploration and send home material to enable us to study more fully the structure and development of the protective coating of shoot and leaf. This covering is interesting. In the dried specimens the one-year-old stem and the petioles are more or less white with irregular flakes of wax which have cracked off the surface as shrivelling has proceeded. The older stems and petioles gradually lose all trace of these flakes. The lamina on the under side is glossy and covered with a uniform wax-stratum. Apparently this peels off in places and by so doing bares the coloured reticulation of the veinlets that in other places from which it has not separated is less conspicuous. The upper surface is much less glossy, and to what degree it is wax-coated I am unable to say on the evidence I have. The whole feature requires for complete understanding living material for dissection. In *Rh. lukiangense*, which is the nearest ally to *Rh. ceraceum* and very like it in many ways, there is the same coating of wax, but in our specimens the coating seems to remain longer

on the surface, yet the effect somehow is of a less shining surface. Otherwise *Rh. lukiangense* can be diagnosed from *Rh. ceraceum* by the unequal corolla-lobes, the spotted corolla, the glabrous pedicels, calyx, stamens, and ovary.

The very glossy surface of the under-leaf in *Rh. ceraceum* distinguishes it at sight from other species which it resembles in many ways and with which it is allied The distinctive association of marks of *Rh. ceraceum* in the series is—the wax-coating, no glands, floccose-tomentose rhachis of inflorescence, puberulous pedicels and calyx, 5-lobed corolla glabrous outside and inside, puberulous ovary.

Rhododendron eritimum, Balf. f. et W. W. Sm.[1]

Shrub reaching about 6 m. in height with thick glabrous branches. Foliage-leaf buds unknown. Leaves shortly

[1] *Rhododendron eritimum*, Balf. f. et W W. Sm.—Frutex ad 6 m. altus ramis crassis glabris. Alabastra et folia juvenilia ignota. Folia breviter petiolata ad 18 cm. longa; lamina subrigida subcrasse coriacea anguste oblonga ad 17 cm. longa ad 4 5 cm. lata apice obtusa subrostrata mucronata margine subrevoluta cartilaginea obscure undulata haud asperata basi anguste cuneata utrinque glaberrima supra olivacea costa media sulcata leviter erubescente venis primariis utrinsecus ad 18 paullo sulcatis caeteroquin minutissime papillata subtus glauca costa media elevata venis primariis erubescentibus et venularum reti immersis caeteroquin laevis obscure aurantiaco-punctulata papillis globosis epidermicis minute induta; petiolus vix 1 cm. longus crassus glaber Flores circ. 15 in inflorescentiam racemoso-umbellatam dispositi rhachi circ. 1·2 cm. longa sparsim (sed in axillis bractearum dense) kermesino-floccosa; bracteae fertiles membranaceae spadiceo-brunneae circ. 2·5 cm. longae circ. 9 mm. latae extus dense albido- et rufo-sericeae intus superne plus minusve adpresso-pubescentes; bracteolae anguste ligulatae 1 cm. longae fere 1 mm. latae pedicellos superantes dense pilosae; pedicelli circ. 8 mm. longi subcrassi floccis paucis conspersi glabrescentes. Calyx minutus circ. 2 mm. longus cupularis glaberrimus, lobis ovatis vel rotundatis vel deltoideis margine subfimbriatis. Corolla lurido-rosea late tubuloso-campanulata ad 4 cm. longa extus intusque glabra varo notata sed emaculata 7 lobata, lobis rotundatis haud magnis circ. 1·3 cm. longis circ. 1·6 cm. latis emarginatis subcrenulatis. Stamina 14 inaequalia longiora circ. 3·3 cm. longa breviora circ. 2 cm. antheris atro-purpureis circ. 3 mm. longis, filamentis vix deorsum latioribus glaberrimis. Discus glaberrimus. Gynaeceum circ. 3·5 cm. longum corolla paullo brevius stamina paullo superans; ovarium cylindricum angustum paullo sulcatum atro-purpureum glaberrimum circ. 5 mm. longum; stylus glaber gracilis in stigma lobulatum haud discoideum paullo ampliatus.

Species *Rh. anthosphaero*, Diels affinis sed foliis anguste oblongis, petiolo glabro, pedicellis brevioribus haud 1 cm. longis eglandulosis, calyce glaberrimo, corolla 7-lobata intus glabra, staminum 14 filamentis glabris, ovario glaberrimo recognoscenda; in forma foliorum *Rh. agasto*, Balf. f. et W. W. Sm. similis sed illa species pedicellos et calyces et ovaria et stylos glandulosos, pedicellos 1 cm. longos, corollae tubum intus puber-

petiolate as much as 18 cm. long; lamina somewhat rigid and thick coriaceous narrowly oblong as much as 17 cm. long 4·5 cm. broad, apex obtuse somewhat rostrate mucronate, margin somewhat revolute cartilaginous obscurely undulate not roughened, base narrow cuneate; both surfaces very glabrous and mat; upper surface olivaceous with a grooved midrib slightly reddening, the primary veins about 18 pairs slightly grooved, the rest of the surface most minutely papillate; under surface glaucous, the midrib raised, the primary veins reddening and like the ultimate reticulation of the veinlets not prominent, the rest of the surface smooth obscurely orange-punctulate, the epidermis marked by minute globose papillae; petiole scarcely 1 cm. long thick glabrous. Flowers about 15 in a racemose-umbel with an axis about 1·2 cm. long sparingly but in the axils of the bracts densely rufously floccose; fertile bracts membranaceous chestnut-brown about 2·5 cm. long and 9 mm. broad, outside densely sericeous with white and rufous hairs, inside in the upper part more or less adpressedly pubescent; bracteoles narrowly ligulate about 1 cm. long and almost 1 mm. broad exceeding the pedicel densely pilose; pedicel about 8 mm. long somewhat thick sprinkled with floccose hairs and glabrescent. Calyx minute about 2 mm. long cupular very glabrous, lobes ovate or rounded or deltoid with a subfimbriate margin. Corolla dark crimson widely tubular-campanulate as much as 4 cm. long, outside and inside glabrous, marked by a blotch but without any spots, 7-lobed; lobes rounded not large about 1·3 cm. long by 1·6 mm. broad emarginate subcrenulate. Stamens 14 unequal, longer about 3·3 cm. long, shorter about 2 cm. long; anthers dark purple about 3 mm. long; filaments scarcely widening to the base and quite glabrous. Disk quite glabrous. Gynaeceum about 3·5 cm. long slightly exceeding the stamens and shorter than corolla; ovary cylindric narrow slightly grooved dark purple quite glabrous about 5 mm. long; style glabrous slender slightly expanding into a lobulate not discoid stigma.

ulum, staminum 10–12 filamenta basi pubescentia, discum floccosum, stigma discoideum possedit; *Rh. hylothreptum*, Balf. f. et W. W. Sm foliis lanceolatis, petiolis glandulosis, pedicellis ultra 1 cm. longis glandulosis, calyce puberulo, corolla intus staminumque filamentis puberulis, disco puberulo distinguitur.

E.N.W. Yunnan:—Mountains of the Chungtien plateau. Alt. 9000 ft. In open thickets. Shrub of 20 ft. Flowers deep plum-crimson, in bud black-crimson. G. Forrest. No. 12,416. March 1914.

A very fine species. By its oblong leaves this species, which belongs to the Irroratum series, is easily picked out amongst its allies. *Rh. agastum* is the only other one of the series with like leaf-form. The character which impresses one particularly in this species is its glabrousness—calyx, corolla, stamens, ovary, and style all are glabrous, and as these are either glandular or puberulous in *Rh. agastum* the differentiation of the two is easily made. The punctulations on the leaves are not very conspicuous. *Rh. eritimum* is a plant of the Chungtien plateau and is only known from there. *Rh. irroratum* extends into the plateau in a remarkably robust form, and these two species have the most northerly distribution of the Irroratum series. Like *Rh. irroratum*, our species has somewhat glaucous foliage, but the leaf-form of *Rh. eritimum* is very different from the pointed lanceolate or oblanceolate type in *Rh irroratum*, and then its large truss of red flowers with 7-lobed corolla and 14 stamens amongst other characters distinguish it.

Rhododendron gymnanthum, Diels in Notes R.B.G. Edin., v (1912), 211.[1]

Shrub with slender branches. Branches a year old about 3 mm. in diameter glabrescent and shining but still showing

[1] The following is the description given by Diels:—

Rh gymnanthum, Diels.—Frutex 0·9–2 m. altus. Folia persistentia; superiorum petiolus ca. 1 cm. longus, lamina papyracea, glabra, oblanceolata, basim versus sensim angustata, apice acuta, 10–12 cm. longa, 2·5–3 cm lata. Racemus brevis terminalis, pedunculi glabri, sepala brevia ca. 1 mm. longa, corolla infundibuliformi-campanulata, rosea, basi purpurea, superius purpureo-punctata vel striolata, 3·5–4 cm. longa, ore 2·5–3 cm. lata; limbi lobi rotundati, 1·5–2 cm. diamet. Stamina 10, filamenta basi paulo latiora, glabra, 2–3 cm. longa. Ovarium 0·5–0·6 cm. longum, conicum, glabrum, stylus ca. 3 cm. longus.

W.N.W. Yunnan:—Mekong-Salween divide, N.W. of Tseku. Alt. 13,000 ft. Lat. 28° 12′ N. Open rocky situations. Shrub of 3–6 ft. Flowers rose with crimson markings.

Similar to *Rh. lukiangense*, Franch. (Tseku, Soulié, No. 1000) but differing by shorter and narrower leaves, larger flowers, and the pedicels not being tomentose [What Diels refers to here is the axis of inflorescence, not the pedicels.]

more or less tufts and vestiges of floccose greasy hairs with which we must assume the stem is at first clad. No foliage buds or younger twigs have been seen. Leaves petiolate as much as 19 cm. long; lamina coriaceous lanceolate or oblanceolate slightly oblique as much as 17 cm. long and 3·5 cm. broad somewhat shortly acuminate, midrib at the tip swollen into a small horny tubercle, margin cartilaginous obscurely undulate and marked by the scars of fallen relatively broad-based hairs, base cuneate or obtuse; upper surface glaucous-green glossy, wax surface-coating sometimes becoming mat, midrib sulcate slightly reddening and lined more or less by withered remains of floccose greasy hairs, primary veins about 18 pairs slightly visible and sometimes vestigially floccose elsewhere the surface glabrous faintly punctulate by orange-coloured bases of fallen hairs; under surface olive-buff-coloured also somewhat glossy, the midrib raised pinkish and glabrous, the primary veins also slightly raised, the ultimate reticulation showing slightly raised in the dried leaf tending to become purple glabrous and showing minute punctulations from the red or orange bases of fallen hairs; petiole as much as 2 cm. long, not very thick slightly erubescent and glabrescent but more or less clad with withered whitish-grey or reddish remains of floccose greasy hairs and marked by the bases of fallen ones. Inflorescence racemose-umbellate about 8 flowers in the truss, the rhachis slender about 2 cm. long glabrescent but with a few remains of floccose greasy hairs and persistent groups of them in axils of outer sterile bracts; bracts and bracteoles unknown; pedicels stout oblique at top, dark brown floccose glabrescent about 1 cm. long. Calyx small about 2·5 mm. long cupular, cup glabrous with 5 somewhat triangular thinnish lobes which are fringed and erose the divisions often gland-tipped. Corolla rose-coloured with a basal posterior blotch and crimson-spotted above funnel-campanulate about 4 cm. long, exceeding in length androecium and gynaeceum, glabrous both outside and inside, 5-lobed, the lobes rounded retuse and somewhat crenulate about 2 cm. long and broad. Stamens 10 unequal, longer ones about 3·4 cm. long, shorter ones about 1·4 cm. long; anthers dark purple about 2·75 mm.

long; filaments hardly widened at base and above the base provided with a few short hairs they are not glabrous. Disk glabrous. Gynaeceum about 4 cm. long exceeding stamens; ovary cylindric about 7 mm. long very narrow about 1·75 mm. in diameter grooved shining brown-black sometimes papillate, glabrous; style glabrous hardly expanding beneath the lobulate small stigma.

W.N.W. Yunnan:—N.W. of Tseku. Mekong-Salween divide. Alt. 13,000 ft. Lat. 28° 12′ N. Open rocky situations. Shrub of 3–6 ft. Flowers rose with crimson markings. G. Forrest. No. 5071. Aug 1904.

W.N.W. Yunnan:—Tseku. Monbeig. No. 4 Herb Kew.

In Herb. Kew there is a good sheet of this under "No. 4 Monbeig," collected at Tseku. Our material at Edinburgh from Forrest, though scanty,—only a twig with five leaves and four flowers—is that upon which Diels founded his species. Through the kindness of the Director of Kew I have had for examination Monbeig's specimen No. 4, and I am able to say that Forrest's specimen is part of the same collecting. In Forrest's early collections are specimens of several different species from Tseku which were of the same collecting as Père Monbeig's, and this is one of them. Hemsley and Wilson[1] referred Monbeig's No. 4 to *Rh. irroratum*, Franch. Later, Rehder and Wilson[2] correctly placed it in *Rh. gymnanthum*. Like most of the Irroratum series this species appears at sight to be quite glabrous, but the evidence of an early floccose condition of axes and leaf are present and the vestiges vary in the degree of their prominence. Except for the glands which tip some of the fringe lobes of the calyx, I have not seen glands upon this plant in its mature state. I have described the disk as glabrous, but in one flower I saw traces of a few very fine short hairs.

I may add a word about the leaf surfaces. The upper is typically glossy from its layer of wax. It is easy to dissolve this in benzol and to remove it, leaving an opaque mat surface. In some of the dried leaves the upper surface is mat—pale and glaucous or olive-green. This seems to be due to a loosening of the wax layer. The under surface

[1] In Kew Bulletin (1910), 113.
[2] Plantae Wilsonianae, i (1913), 539.

is also but less prominently wax-coated. These wax-coatings in the series require further investigation. As I have pointed out on a preceding page, they are developed in varying degree in several species, being particularly evident in *Rh. ceraceum* where the under surface is particularly glossy the upper surface less so, and in all the immediate allies of *Rh. gymnanthum* the under surface has a somewhat shining look from the presence of wax.

Along with *Rh. araiophyllum*, *Rh. mengtszense*, *Rh. spanotrichum*, and *Rh. tanastylum*, the species belongs to that set within the Irroratum series which shows narrow lanceolate or oblanceolate leaves and 5-lobed corolla, glabrous inside and out. *Rh. araiophyllum* is a white-flowered plant with open campanulate corolla and puberulous ovary. *Rh. mengtszense* is a gland-setose plant and readily differentiated by the character *Rh. spanotrichum* has shorter leaves not glossy above, much more definitely oblanceolate, and its corolla is not funnel-campanulate and its staminal filaments are glabrous *Rh. tanastylum* has also much shorter leaves but glossy above, and the corolla is tubular-campanulate, the stamens glabrous. Diels mentions and Rehder and Wilson also refer to a likeness of *Rh. gymnanthum* to *Rh. lukiangense*, but the species are very different (see under *Rh. lukiangense*, p. 203).

Rhododendron hylothreptum, Balf. f. et W. W. Sm.[1]

Tree about 9 m. high with thickish branches. Young branches about 3 mm. in diameter densely floccose with

[1] *Rhododendron hylothreptum*, Balf. f. et W. W. Sm.—Arbor ad 9 m. alta ramis subcrassis Ramuli hornotini circ. 3 mm. diam. dense floccosi (pilorum ramis brevibus) et clavato-glandulosi glandulis rufis vel aurantiacis, seniores earum vestigiis vestiti. Alabastrorum elongato-ovoideorum subviscidorum perulae exteriores late ovatae vel subrotundatae crustaceo-coriaceae brunneae circ. 6 mm. longae ecarinatae haud mucronulatae extus plus minusve rufo-glandulosae intus pilis sebaceis indutae obscure ciliatae, interiores membranaceae spathulatae circ. 3 cm. longae circ. 7 mm. latae spadiceo-brunneae extus puberulae glandulisque vestitae intus plus minusve puberulae apicem versus sericeae vertice acutatae sebaceo-ciliatae; folia juvenilia revoluta supra pilis floccosis longe ramosis et glandulis clavatis paucis dense induta subtus glandulis clavatis et pilis paucioribus breviter ramosis vestita, margine pilis pede lato praedita; petiolus juvenilis dense clavato-glandulosus et pilis floccosis obtectus. Folia petiolata ad 13 cm. longa; lamina chartacea lanceolata nunc oblanceolata ad extremitates attenuata ad 11·5 cm. longa ad 3·5 cm. lata apice acuta corneo-tuberculata margine plana cartilaginea obscure

branched short hairs and also clavately glandular with red or orange glands; older branches marked with the remains of these. Scale-leaves on the outside of the elongated ovoid somewhat viscid buds broadly ovate or somewhat rounded crustaceously coriaceous brown about 6 mm. long without a dorsal keel and not mucronate, more or less rufously glandular on the back, on the inner surface lined by greasy hairs, obscurely ciliate; inner scale-leaves membranaceous spathulate about 3 cm. long 7 mm. broad chestnut-brown puberulous on the back and clad with glands, more or less puberulous within and towards the apex sericeous, the acutish summit being ciliate with greasy hairs; juvenile leaves revolute upper surface densely clad with many-branched floccose hairs and a few clavate glands, under side covered with clavate glands and a smaller number of shortly branched hairs, margin girt by broad-

undulata et pedibus pilorum juvenilium delapsorum minute subasperata basi obtuse vel plus minusve late cuneata supra olivacea opaca costa media sulcata sulco glandulis paucis rubris et pilis ramosis marcidis notato venis primariis utrinsecus circ. 14 paullo sulcatis caeteroquin plana glaberrima floccorum juvenilium vestigiorum inopia notata subtus fulva nunc subnitens costa media elevata leviter erubescente minute puberula et glandulis rubris paucis vel earum vestigiis conspersa venis primariis etiam elevatis caeteroquin subpuberula et glandularum juvenilium pedibus minute punctulata epidermide globoso-papillata; petiolus ad 1·5 cm. longus crassus supra sulcatus glandulis pilisque et earum vestigiis plus minusve obtectus saepe glabrescens. Flores circ. 12 in inflorescentiam racemoso-umbellatam dispositi rhachi ad 1·7 cm. longa pilis floccosis multo ramosis sebaceis rubris plus minusve dense vestita, bracteae deciduae fertiles obovato-oblongae membranaceae extus dense sericeae et glandulosae intus sericeae; bracteolae lineares circ. 9 mm. longae rufae adpresso-pilosae; pedicelli ad 1·5 cm. longi validi glandulis clavatis et pilis sebaceis rufis floccosis conspersi. Calyx cupularis cupula dense glandulosa circ. 2 mm. longus carnosulus, lobis deltoideis vel triangularibus extus plus minusve puberulis margine eglandulosis rarissime glandulis paucis notatis Corolla late tubuloso-campanulata circ. 4·5 cm. longa genitalia superans basi 7-gibbosa retusa extus glabra intus puberula postice variculata et maculata 7-lobata, lobis circ. 1·7 cm. longis circ. 2 cm. latis rotundatis emarginatis subcrenulatis. Stamina 14 inaequalia longiora circ. 3 cm. longa breviora circ. 2 cm. longa, antheris atro-purpureis circ. 2·5 mm. longis, filamentis roseis a basi ima saepe ad medium copiose pubescentibus. Discus minutissime puberulus. Gynaeceum circ 3·5 cm. longum; ovarium 6 mm. longum conoideum nigrescens sulcatum glabrum sed rarissime glandulis singulis paucissimis nunc floccis sebaceis plus minusve conspersum; stylus glaber stamina superans in stigma lobulatum haud discoideum paullo clavatum ampliatus.

Species *Rh. anthosphaero*, Diels similis sed calycis cupula glandulosa lobisque puberulis, corolla 7-lobata, staminibus 14, filamentis ad medium copiose pubescentibus, disco minutissime puberulo, ovario glabro bene distincta.

based hairs; juvenile petiole densely clavate-glandular and floccose. Leaves petiolate as much as 13 cm. long; lamina chartaceous lanceolate occasionally oblanceolate narrowed at the extremities as much as 11 5 cm. long 3·5 cm. broad, acute at the apex and crowned by a horny tubercle, margin flat cartilaginous obscurely undulate and minutely roughened by the bases of fallen juvenile hairs, obtuse or more or less broad cuneate at the base; upper surface olivaceous mat with a grooved midrib the groove containing a few red glands and the withered remains of branched hairs, primary veins about 14 pairs slightly grooved, otherwise the surface is flat very glabrous wanting apparently conspicuous vestiges of juvenile flocks; under surface tawny sometimes somewhat glossy midrib elevated erubescent minutely puberulous and sprinked with scattered red glands or their vestiges, primary veins also raised, elsewhere the surface is somewhat puberulous and minutely punctulate, epidermis globosely papillate; petiole as much as 1·5 cm. long thick grooved above and covered with glands and hairs or their vestiges often glabrescent. Flowers about 12 arranged in a racemose-umbel with a rhachis 1·7 cm. long, the axis more or less densely covered with floccose much-branched greasy red hairs; bracts deciduous fertile ones obovate-oblong or oblong membranous, outside densely sericeous and glandular, inside sericeous; bracteoles linear about 9 mm. long rufous with adpressed hairs; pedicels about 1·5 cm. long stout sprinkled with clavate glands and greasy rufous floccose hairs. Calyx cupular, cup about 2 mm. long densely glandular fleshy with deltoid or triangular; lobes more or less puberulous outside, margin eglandular rarely with one or two glands. Corolla broadly tubular-campanulate about 4·5 cm. long exceeding the androecium and gynaeceum, 7-gibbous and retuse at the base, glabrous outside puberulous inside with a blotch and spots on the back, 7-lobed; lobes about 1·7 cm. long and 2 cm. broad rounded emarginate subcrenulate. Stamens 14 unequal, the longer about 3 cm. long, shorter 2 cm.; anthers dark purple 2·5 mm. long; filaments rose-coloured abundantly pubescent from the very base often to the middle. Disk most minutely puberulous. Gynaeceum about 3·5 cm. long; ovary 6 mm. long conoid blackening

grooved glabrous very rarely with a few solitary single glands occasionally sprinkled with floccose greasy hairs; style glabrous longer than the stamens slightly expanding into a slightly clavate apex under the lobulate not discoid stigma.

E.N.W. Yunnan:—Summit of the Sungkwei pass. Alt. 11,000–12,000 ft. Open situations. Shrub of 10–15 ft. Flowers deep magenta-rose with darker markings. G. Forrest. No. 5845 May 1910; in rhododendron forests. Tree of 20–30 ft. G. Forrest. No. 5848. May 1910.

A species which recalls *Rh. anthosphaerum*, Diels, and it comes from the same area—the Sungkwei Pass—but it is quite distinct.

Like *Rh. anthosphaerum* it has broadly lanceolate leaves darkly olivaceous on the upper surface, punctulate below, and there the midrib sometimes shows a few glands. The petioles are usually shorter than in *Rh. anthosphaerum*. Here the corolla is 7-lobed and the stamens correlatively 14. This has not been seen in *Rh. anthosphaerum*, where 5–6 petaline lobes and 10–12 stamens in the flower are met with. Whether or no this is a critical difference future observation must determine. It is in the material we possess definitely diagnostic. Other characters distinguishing *Rh. hylothreptum* from *Rh. anthosphaerum* are the puberulous calycine lobes, the filaments of the stamens copiously puberulous to the middle or beyond not merely finely puberulous at the base, the typically glabrous ovary.

The species is in cultivation under No. 5848, and we have at Edinburgh several plantlets. All of these do not show the characters we expect in *Rh hylothreptum*, but they are too young as yet to offer sound evidence in reply to the question—What are they? The dried specimens show the plant as most floriferous, and, coming as it does from a high altitude in the north-west of Yunnan, we may expect it to be thoroughly hardy. The flower colour does not, however, appear to be of depth and intensity sufficient to give it a prominent claim for favour in gardens in competition with species of the Sanguineum series or the Thomsoni series.

In addition to the Nos. 5845 and 5848 cited above, we have another plant from Forrest, with the label:—

"E.N.W. Yunnan:—Near the summit of the Sungkwei

pass. Alt. 10,000 ft. Lat. 26° 12′ N. In rhododendron forest. Tree of 20–30 ft. Flowers crimson-rose with deep crimson markings. G. Forrest. No. 5852. May 1910."

This is our species, but it shows the ovary clad more or less with solitary or floccose hairs. In this there is an approach to *Rh. anthosphaerum*.

Rhododendron irroratum, Franch. in Bull. Soc. Bot. France, xxxiv (1887), 280;[1] Hemsl. in Journ. Linn. Soc., xxvi (1889), 26; Bot. Mag. (1894), t. 7361.

Shrub reaching as much as 9 meters in height. New shoots of the year about 3 mm. in diameter rufo-tomentose densely clad with shortly-stalked clavate rufous glands which soon fall; branches a year old tawny and with blackened gland-vestiges, ultimately a dirty grey and decorticating. Foliage buds sticky oblong covered outside with dark-brown crustaceo-coriaceous scale-leaves semilunate or rotundate cucullate without a keel slightly ciliate at tip with greasy short hairs, glabrous inside, glandular and puberulous on back; intermediate scale-leaves oblong obovate; inner ones membranous as much as 3·8 cm. long yellowish ligulate-spathulate acute, outside and inside clad with clavate rufous shortly-stalked glands with at the tip a group of floccose greasy hairs; young leaves revolute in ptyxis, upper surface densely covered with an indumentum of floccose hairs having a broad foot and long or short thick stalk giving off more or less greasy branches, margin fringed with like flocks and with stalked clavate

[1] Franchet's description runs:—

Rhododendron irroratum, Franch.—Frutex circiter 6-pedalis, ramis et ramulis glabris; folia usque 5 poll. longa, nunc minora, breviter (7–10 mill.) petiolata, e basi attenuata lanceolata, apice acuta, mucronata, glauca, rigida, glaberrima, nervis secundariis usque 12–15 subtus prominulis; flores ad anthesin glomerati, mox laxi, albi, intus punctis fuscis confertis irrorati, pedunculis 10–12 mill. longis glandulis tenuibus adspersis; calyx inter minimos, extus dense glandulosus, lobis obsoletis rotundatis; corolla extus glabra, intus in parte inferiore puberula, haud magna (vix ultra pollicáris), aperte campanulata, lobis 5 rotundatis; stamina 10, inclusa, filamentis inferne brevissime ciliatis, ovarium glandulis minutis fuscis dense obtectum; stylus gracilis stamina superans, ad apicem usque glandulosus.

Yunnan, in silvis ad Pee tsao-lo, supra Mo-so-yn, prope Lankong, alt. 2500 m., fl. 9 April (Delav. n. 2352).

Très jolie espèce, remarquable par sa teinte glauque et par ses fleurs blanches abondamment mouchetées de brun.

red glands which may be numerous; under surface more sparingly beset with shorter cauliflower glands or solitary greasy hairs; petiole densely glandular. Leaves petiolate as much as 14·5 cm. long usually less; lamina rigid thick coriaceous usually narrowed to both ends lanceolate or oblanceolate as much as 12·5 cm. long and 3 cm. broad, somewhat acute at the tip with a horny tubercle, margin broadly cartilaginous slightly revolute the edge roughened or notched owing to projecting reddish feet of fallen juvenile hairs, base obtuse or slightly rounded; upper surface pale glaucous green, midrib deeply grooved, primary veins about 16 pairs pinnately spreading at a wide angle slightly grooved, whole surface glabrescent with vestiges of the juvenile hairs; under surface paler usually fawn-colour, midrib and primary veins elevated straw-coloured, whole surface minutely punctulate by red bases of fallen juvenile cauliflower glands or greasy hairs. petiole as much as 2 cm. long usually less, grooved above, thick somewhat fleshy slightly reddened, more or less glandular or marked by vestiges of fallen stalked rufous glands or hairs. Inflorescence shortly racemose umbellate many flowered (over 15), rhachis up to 3 cm. long (often shorter) rufously glandular; bracts outer sterile tawny rounded sometimes apiculate, margin ciliate, clad like outer perulae of foliage buds, inner fertile oblong-spathulate subtruncate submembranaceous about 3·5 cm. long 1 cm. broad, densely sericeous, outside with single white hairs towards apex mixed with glands and floccose greasy hairs, inside glabrous except at apex where is a tuft of white crumpled hairs; bracteoles filiform slightly wider at insertion silkily pilose about 1·8 cm. long or shorter, longer than pedicel; pedicel pale yellow-green about 1·3 cm. long stout glandular with clavate crimson glands. Calyx minute about 2 mm. long cupular densely glandular outside with 5-rounded semi-lunate or ovate or broadly triangular lobes, gland-fringed always epilose. Corolla white or pale yellow or greenish-white with more or fewer crimson spots (there may be many on all the petals) sometimes only a few on the posterior petal and without a blotch posteriorly somewhat fleshy variable in size from 3 to 5·5 cm. long, always longer than stamens and gynaeceum, tubular-

campanulate, 5-lobed, at base 5-gibbous and retuse, outside more or less glandular with short-stalked clavate crimson glands specially on mid-veins of the lobes, inside densely puberulous; lobes rounded emarginate slightly crenulate, in smaller flowers 1·7 cm. long by 2·2 cm. broad, in larger flowers 2 cm long by 3 cm. broad. Stamens 10 unequal, in smaller flowers longer ones 3 cm. long, shorter 2·3 cm. long, in larger flowers longer 4·5 cm long, shorter 3·5 cm. long; anthers about 3·5 mm. long dark brown; filaments eglandular slightly wider at base and there finely puberulous from the very base to about top of ovary. Disk most glabrous. Gynaeceum in smaller flowers about 3·3 cm. long, in larger 4·5 cm.; ovary blackening conoid grooved about 5 mm. long and 2·5 mm. in diam. densely clavate-glandular sometimes with a few solitary hairs or flocks of greasy hairs at very base; style red-glandular throughout not expanding below the lobulate stigma but forming a narrow ring.

Specimens I have seen are:—

E.N.W. Yunnan:—In woods at Peetsaolo above Mosoyn, near Langkiung. Alt. 2500 m. In flower, 9th April Delavay No. 2352.

E.N.W. Yunnan:—Ascent of the Sungkwei pass from the Langkiung valley. Alt. 9000–10,000 ft. Lat. 26° 30′ N. Shady pine and rhododendron forest Erect shrub of 10–15 ft. Corolla yellowish-white, with a few markings of a greenish-yellow, thick and fleshy. G. Forrest No. 2043. April 1906.

E.N.W. Yunnan:—Near the summit of the Sungkwei pass ascending from the Langkiung valley. Alt. 11,000 ft. Lat. 26° 30′ N. Open situations. Spreading shrub of 10–15 ft. Corolla greenish-white, profusely marked small dark crimson spots. G. Forrest. No. 2058. April 1906.

Mid. W. Yunnan:—Eastern flank of the Tali Range. Alt. 11,000–12,000 ft. Lat. 25° 40′ N. Open rocky situations. Shrub of 8–12 ft. Flowers white with a few crimson markings. G. Forrest. No. 4146. July 1906.

E.N.W. Yunnan:—Summit of the Sungkwei pass. Alt. 11,000–12,000 ft. Lat. 26° 12′ N. In rhododendron forest. Shrub or tree of 15–30 ft. Flowers pale yellow with crimson markings. G. Forrest. No. 5851. May 1910.

E.N.W. Yunnan:—Langkiung-Hoking divide. Alt. 10,000–11,000 ft. Lat. 26° 25′ N. In rhododendron thickets. Shrub of 10–30 ft. Flowers pale yellow, spotted crimson. G. Forrest. No. 10,023. May 1913.

E.N.W. Yunnan:—Langkiung-Hoking divide. Alt. 9000–10,500 ft. Lat. 26° 25′ N. In rhododendron thickets. Shrub of 20 ft. Flowers white, with a few rose markings flushed rose exterior. G. Forrest. No. 10,032. May 1913.

E.N.W. Yunnan:—Mountains of the Chungtien plateau. Alt. 9000–10,000 ft. Lat. 27° 30′ N. In open thickets. Shrub of 20 ft. Flowers yellowish, white margined rose with deep crimson markings. G. Forrest. No. 12,410. April 1914.

The above record shows that the species has a comparatively large area of distribution in Yunnan. Beginning in the south on the eastern flank of the Tali Range it occurs near Langkiung, the earliest known locality, and apparently is common about that region having been found on the Langkiung-Hoking divide, and in the Sungkwei pass leading out of the Langkiung valley; much farther north it appears on the Chungtien plateau. It is a wonderfully constant type over its area. Some degree of variation it exhibits. In size of leaf, for instance; also in size of flower—and this is the most noteworthy. In Delavay's Langkiung specimen the corolla is, as Franchet says, not large—it does not reach 3·7 cm.—but in some of Forrest's specimens from the Langkiung-Hoking divide (No. 10,032 in particular) the corolla is at least 5·5 cm. long and all the other flower-parts have correlative size-modification. Franchet says nothing of a character of some import diagnostically—the presence of crimson glands on the outside of the corolla. These occur on Delavay's plant (No. 2352), which, through the kindness of M. Lecomte of the Paris Herbarium, I have been enabled to examine. In Forrest's specimens they are prominent, particularly on the mid-veins of the petals, but sometimes a vein may show none.

The species is one of the most easily recognised of all rhododendrons. The rigid more or less lanceolate glaucous apparently quite glabrous leaves are characteristic; their somewhat fawn-coloured under-leaf surface is always

minutely punctulate and the cartilaginous undulate margin is more or less notched and conspicuously punctulate. The upper surface, which in the young leaf is much more densely coated with hairs than is the under surface,—this the consequence of a revolute ptyxis—does not show conspicuously such coloured bases of its fallen hairs, but vestiges of these hairs may be seen, specially about the midrib. The more or less glandular petiole is a character of mark. In the flower region the following characters are important:—the glandular axis of inflorescence, the glandular pedicels, the 5-lobed corolla glandular outside puberulous inside, the filaments of stamens very finely puberulous from base to top of ovary, the rufously glandular ovary without hairs though occasionally at base of and on the ovary a few greasy coloured hairs may occur, the style glandular right to the top and there ending in a stigma which is hardly broader than lower part of style.

Rh. irroratum was brought into cultivation through the Jardin des Plantes of Paris, where it was raised from seeds sent by Delavay. It flowered for the first time in Britain at Kew in 1893, and is figured in the Botanical Magazine (1894), t. 7361. It has flowered elsewhere since then, and seems to be variable in flower colour. Sir Joseph Hooker wrote of it as "in its present condition the least ornamental species of the genus known to me," expressing the hope that when older its merits would be higher. We have it growing at Edinburgh under Forrest's No. 5851, which, through the dried specimens, does not promise to be much better than Delavay's plant. The form from the Chungtien plateau under Forrest's No. 12,410 is evidently much finer.

Rhododendron lukiangense, Franch. in Journ. de Bot., xii (1898), 257.[1]

Shrub with medium thick branches. Branchlets a year old as much as 5 mm. in diameter, pale green covered with

[1] Franchet's description runs:—
Rh. lukiangense, Franch.—Folia petiolata, coriacea, utraque facie glaberrima, multicostata, e basi attenuata lanceolata, superne breviter acutata, 13–17 cent. longa, 30–45 mm. lata, perulae florales diu persistentes, extus albo lanatae, oblongae; flores 6–8, apice ramorum congesti, rubri; pedicelli 3–4 mm. longi; calycis glabri segmenta vix con-

a surface stratum of white desquamating wax or its vestiges. Foliage-leaf buds and juvenile leaves unknown. Leaves petiolate as much as 17·5 cm. long; lamina of consistence of parchment long lanceolate occasionally oblanceolate narrowed to both ends, as much as 16 cm. long and 4·5 cm. broad, apex acute or acuminate not beaked ending in a horny hydathodal tubercle, margin slightly recurved cartilaginous obscurely undulate and minutely marked by the bases of fallen juvenile hairs, base obtuse; upper surface olivaceous somewhat glossy, very glabrous, the midrib not reddening grooved, primary veins as many as 25 pairs hardly conspicuous, elsewhere conspicuously reticulate (in dry state); under surface tawny hardly punctulate very glabrous, midrib and primary veins elevated, the network of the ultimate veins reddish, the whole surface somewhat glossy smooth as if wax-varnished the coating in places obscuring the ultimate venation, epidermis epapillate; petiole thick about 1·5 cm. long wrinkled grooved above apparently glabrous but clad with a desquamating white (often blackening) stratum of wax. Flowers of the inflorescence about 8, racemosely umbellate, the axis of inflorescence about 1·5 cm. long densely tomentose with white floccose adpressed hairs; fertile bracts membranaceous tawny spathulate as much as 2 cm. long and 7 mm. broad, apex rounded or somewhat truncate and emarginate, ciliate, outside densely silky throughout, inside near apex in the middle silky; bracteoles filiform adpressed-pilose throughout about 1 cm. long; pedicels scarcely 1 cm long glabrous brown. Calyx cupular minute about 1·5 mm. long outside glabrous; lobes deltoid sometimes broadly semi-lunate minutely fimbriate. Corolla red (?), tubular-campanulate as much as 4·3 cm. long exceeding the stamens and gynaeceum, outside and inside glabrous, red-spotted posteriorly, 5-lobed; lobes unequal posterior slightly larger

spicua ; corolla 25-30 mm. longa, anguste campanulata 5-loba ; ovarium, stylus totus et staminum filamenta 10, perfecte glabra ; stamina et stylus haud exserta.

Vallée du Loukiang, à Tsékou (Soulié, n. 1000 ; 16 mars 1895).

Assez voisin du *Rh. arboreum* et des espèces du même groupe, c'est-à-dire de celles qui ont 10 étamines et une corolle à 5 lobes, mais distinct par l'état complètement glabre de l'androcée et du gynécée ; le *Rh. Bonvaloti* auquel il ressemble surtout a le gynécée et l'androcée glanduleux.

about 1·5 cm. long and 2 cm. broad rounded emarginate more or less crenulate. Stamens 10 unequal, longer about 3·3 cm. shorter about 2 cm. long; anthers dark purple in longest stamens about 3 mm. long, in shortest 2 mm.; filaments slightly flattened at the base scarcely widened, glabrous throughout, eglandular. Disk pubescent. Gynaeceum about 3·8 cm. long slightly exceeding the stamens, shorter than corolla; ovary black-purple slightly grooved narrow cylindric about 8 mm. long by 2 mm. in diameter glabrous; style glabrous slightly clavately expanded under the lobulate stigma.

W.N.W. Yunnan:—Tseku. Valley of Loukiang. Soulié. No. 1000. 16th March 1895.

Franchet's diagnosis of this species, sufficient for its purpose at the time of publication, is inadequate now that we have so many more species to deal with in the Irroratum alliance. I have therefore drawn up this fuller description. For the means of doing this I am indebted to M. Lecomte of the Paris Herbarium, who has given himself much trouble on my behalf, for which I wish to express my warm thanks. I received from him a drawing of the type-sheet in the Paris Herbarium, and subsequently beautiful specimens of Soulié's collecting. Upon these my description is based.

The species finds its nearest ally in *Rh. ceraceum*, and comes naturally into the set which includes also *Rh. anthosphaerum* and *Rh. hylothreptum*. Like *Rh. ceraceum*, it has the peculiar wax covering over the under surface of the leaf, but the glossy sheen is not so bright It appears to be a larger-leaved and larger-flowered plant than *Rh. ceraceum*. In the flower itself the unequal corolla lobes spotted posteriorly and the glabrous pedicels, calyx, stamens, and ovary are diagnostic. One may look on it as a glabrous edition of *Rh. ceraceum*.

Diels thought his *Rh. gymnanthum* to be similar to *Rh. lukiangense*, differing in, amongst other characters, its glabrous not tomentose pedicels. But the pedicels in both are glabrous. What Diels saw was the tomentose axis of inflorescence in *Rh. lukiangense*, and that is very different from the glabrescent rhachis of *Rh. gymnanthum*. Other characters separating the species are the wax-coated not floccose stems and petioles of *Rh. lukiangense*, its

glabrous not floccose pedicels, its glabrous not puberulous stamens, its pubescent not glabrous disk.

I will not quarrel with Franchet's ascription of *Rh. lukiangense* to the Arboreum group of Rhododendrons embracing "species with 5-lobed corolla and 10 stamens"—only the great increase in the number of known Rhododendrons since he wrote compels endeavour to find smaller phyletic groups within the genus, and the Irroratum series is a product. The Arboreum series of Rhododendron centering in the Himalayan *Rh. arboreum*, with its allied forms *Rh. Campbelliae*, *Rh. cinnamomeum*, *Rh. Kingianum*, *Rh. nilagiricum*, *Rh. Rollissonii*, and so forth, is represented in China by *Rh. Delavayi*, which also seems to have some distinct enough allied forms, and the series can be readily separated by valid marks as a phylum from the Irroratum series. It is true that the general habit of some members of the Irroratum series recalls the Arboreum habit, and there is also often the compact truss of red flowers, but the indumentum of the Arboreums has a very different construction from that of the Irroratums. This and the many other distinctions between the series I must leave over for another occasion of writing. Only one thing further will I say here, that no one of the Chinese Irroratums can compare in consistency of corolla and intensity of colour with *Rh. arboreum*. And this is not an isolated case in a comparison of the Rhododendrons of the two areas. As a whole the large Sikkim Rhododendrons bear the palm in these respects over the Chinese—only in some of the dwarfer Chinese forms is there rivalry.

Franchet also mentions *Rh. Bonvaloti*, Franch. as a species which *Rh. lukiangense* "specially resembles." I have knowledge of *Rh. Bonvaloti* only in a fragmentary specimen, and it would lead me to exclude it from the Irroratum series, but I shall have to deal with *Rh. Bonvaloti* at another time.

Rhododendron mengtszense, Balf. f. et W. W. Sm.[1]

Tree reaching a height of about 6 m. with slender branches covered with the agglutinated remains of seti-

[1] *Rhododendron mengtszense*, Balf. f. et W. W. Sm.—Arbor ad 6 m. alta tenuiramosa glandularum setiformium et cataphyllorum et bractearum annorum praeteritorum vestigiis agglutinatis obtecta. Rami apicem

form glands, scale-leaves, and bracts of previous years. Branches viscid towards the summit, about 4 mm. in diameter, densely clad with red clavate glands with long red stalks, setiform. Foliage buds unknown. Leaves petiolate reaching 18 cm. in length; lamina chartaceous firm narrowly oblanceolate as much as 16·5 cm. long 3·5 cm. broad narrowing to the somewhat beaked and acutish apex, margin cartilaginous obscurely undulate and somewhat rufous reddened by the bases of fallen hairs, narrowing to the unequal somewhat obtuse base; upper

versus viscidi circ. 4 mm. diam. glandulis rubris clavatis longe rubro-stipitatis setiformibus dense obsiti. Alabastra ignota. Folia petiolata ad 18 cm. longa; lamina chartacea firma anguste oblanceolata ad 16·5 cm. longa ad 3·5 cm. lata apice attenuata subrostratim acutiuscula margine cartilaginea obscure undulata et pedibus pilorum delapsorum subaspera deorsum attenuata basi inaequaliter obtusa supra opaca haud nitens olivacea costa media sulcata sulco pilis sebaceis et glandulis marcidis impleto venis primariis utrinsecus circ. 16 haud prominulis caeteroquin plana et primo aspectu glaberrima sed pedibus rubris glandularum vel pilorum floccosorum delapsorum minutissime punctulata et setis paucis conspersa subtus fulvida costa media venisque primariis elevatis erubescentibus ex toto glandulis rubris setiformibus et pilis sebaceis albidis vel rubris floccosis vel eorum vestigiis indutis venularum reti paullo conspicuo et similiter sparsim punctulato; petiolus ad 1·5 cm. longus crassus setis longis rubris tandem nigricantibus glandulosis densissime ex toto vestitus. Flores breviter racemoso-umbellati circ. 8 in inflorescentia quaque terminali rhachi circ. 1 cm. longa glanduloso-setosa; bracteae steriles rotundatae crustaceo-coriaceae intus plus minusve sericeo-puberulae margine tenuiores, fertiles late obovatae circ. 2 cm. longae supra circ. 1 cm. latae extus et intus sericeae eglandulosae margine apiceque pilis rubris fimbriatae; bracteolae lineares uninerviae adpresso-pilosae fere pedicellos aequantes; pedicelli ad 2 cm. longi crassi sub flore obliqui densissime glanduloso-setosi glandularum stipitibus rubris longis et brevibus. Calyx parvus circ. 2 mm. longus cupularis carnosulus, cupula dense glanduloso-setosa glandulis rubris, lobis deltoideis purpureis glabris. Corolla purpureo-rosea aperte campanulata circ. 3·8 cm. longa extus intusque glabra postice varo basali coccineo notata emaculata basi 5 gibbosa retusa 5-lobata, lobis circ. 1·6 cm. longis circ. 2 cm. latis rotundatis emarginatis subcrenulatis. Stamina 10 inaequalia, longiora circ. 3 cm. longa breviora circ. 1 5 cm. antheris circ. 4 mm. longis brunneis, filamentis deorsum paullo latioribus a basi ima ad apicem ovarii puberulis. Discus albido-pubescens. Gynaeceum circ. 3·8 cm. longum; ovarium circ. 5 mm. longum cylindricum profunde sulcatum nigrescens glandulis rubris plurimis longe rufo-stipitatis subadpressis densissime obtectum et setis paucioribus longis (circ. 4 mm.) sebaceis rufis adscendentibus acutatis intermixtis praeditum; stylus ex toto rubro-glandulosus glandulis inferis longe superis breviter stipitatis sub stigmate lobulato vix expansus.

Species *Rh. gymnantho*, Diels affinis ramulis et petiolis et inflorescentiae rhachi et pedicellis et calyce et ovario glanduloso-setosis, foliis supra opacis haud nitentibus, pedicello 2 cm. longo, disco pubescente, stylo glanduloso facile recognoscenda.

surface mat not glossy, olivaceous, midrib grooved the groove more or less filled with withered greasy hairs and glands, primary veins about 16 pairs not prominent, surface elsewhere flat and at first glance very glabrous but minutely punctulate by the red bases of glands or floccose hairs, some setiform glands may be seen about the midrib towards the base; under surface tawny somewhat glossy the midrib and primary veins raised and reddening covered throughout by red setiform glands and greasy white or red floccose hairs or by their vestiges, network of the ultimate veins slightly conspicuous and sparingly punctulate; petiole reaching 1·5 cm. in length thick, clad throughout with long red glandular blackening setae. Flowers shortly racemose-umbellate about 8 in each terminal truss, axis of inflorescence about 1 cm. long glandular setose; sterile bracts rounded crustaceously coriaceous, more or less sericeo-puberulous inside, thinner at the margin, fertile bracts broadly obovate about 2 cm. long 1 cm. broad, outside and inside sericeous eglandular, margin and apex fimbriate with red hairs; bracteoles linear almost equalling the pedicels one-nerved with adpressed long hairs; pedicels reaching 2 cm. long thick, oblique under the flower, very densely gland-setose the glands having red stalks some long some short. Calyx small about 2 mm. long cupular fleshy, the cup densely gland-setose with red glands, lobes deltoid purple glabrous. Corolla purple-rose openly campanulate about 3·8 cm. long, glabrous both outside and inside marked at the base inside by a crimson blotch unspotted, with 5 basal gibbosities retuse, 5-lobed; lobes about 1·6 cm. long 2 cm. broad rounded emarginate subcrenulate. Stamens 10 unequal, the longest about 3 cm. long the shortest about 1·5 cm. long; anthers 4 mm. long brown; filaments widening to the base and from there to the top of the ovary puberulous. Disk whitely pubescent. Gynaeceum about 3·8 cm. long; ovary about 5 mm. long cylindric deeply grooved blackening covered with many red long-stalked setulose glands and with a smaller number of long setae (as much as 4 mm. long) which are sebaceous and red ascending sharp-pointed; style throughout red-glandular the lower glands with long stalks, the upper ones with shorter, hardly expanded under the lobulate stigma.

S.E. Yunnan:—Mengtsz. Mountain forests to south-east. 7000 ft. Tree 20 ft. Flowers purple-red. Henry. No. 10,275. In Herb. Kew et Edin

A species with the general characters of the Irroratum series, and probably approaching most nearly to *Rh. gymnanthum*, Diels. It has the long narrow leaves of that species, but a glance suffices to distinguish them. Here the upper surface of the leaves is a mat dull olive-green, in *Rh. gymnanthum*, Diels the upper surface is a bright glossy glaucous green. Then the remarkable development of glandular setae is a feature not seen in *Rh. gymnanthum*, nor, indeed, in any other of the Irroratum series. These setae form a thick persistent sheath on the petioles and stems and on the ovary are most striking. All the setae are not glandular, some of them have pointed ends, and are much longer than those with glands reaching in length as much as 4 mm. The leaf-surfaces at maturity are conspicuously red-punctulate, more so indeed (particularly the upper surface) than in some others of the Irroratum series. The glands themselves are frequently persistent, especially on the primary veins, and the flocks of greasy hairs are also often persistent, particularly on or about the midrib and markedly towards its base. In the last-mentioned character *Rh. mengtszense* recalls its ally *Rh. araiophyllum*, where the flocks remain sometimes as a dense tomentum.

By its openly campanulate corolla it also differs from *Rh. gymnanthum*, where the corolla is funnel-shaped, and, in addition to the setose ovary already mentioned, the glandular style marks it off from *Rh. gymnanthum*, in which both ovary and style are glabrous.

Diagnostic characters separating *Rh. mengtszense* from *Rh. irroratum* are no less conspicuous. These are the longer and narrower leaves, the gland-setose indumentum, the corolla without glands outside and glabrous inside, and the pubescent disk.

Hemsley and Wilson[1] take this plant with others (Nos. 10,301, 10,853, 11,066, 11,067, 11,067B) of Henry's collecting in S.E. Yunnan to be *Rh. irroratum*, Franch., associating with it also a Tseku specimen No. 4 of Monbeig and Forrest's Nos. 2043, 2058, 4146. Rehder and Wilson[2] refer

[1] In Kew Bull. (1910), 112. [2] Plantae Wilsonianae, I (1913), 539.

Monbeig's plant to *Rh. gymnanthum* and make the suggestion that Henry's No. 10,275 (our *Rh. mengtszense*) and the other Henryan plants mentioned (they say nothing about 10,301) "might be considered as constituting a pubescent variety of *Rh. gymnanthum.*" Rehder and Wilson are right in identifying Monbeig's No. 4 as *Rh. gymnanthum*, and in bringing Henry's No. 10,275 nearer to *Rh. gymnanthum* than to *Rh. irroratum*: but there is not identity between any of Henry's specimens and either *Rh. gymnanthum* or *Rh. irroratum.* They can all be separated by quite satisfactory characters as distinct species, and I am describing some of them in these pages. Henry's specimens are to be identified thus —

No. 10,275 is *Rh. mengtszense*, Balf. f et W. W. Sm.

No. 10,301 is probably the same as Hancock's No. 179 from Mengtsz, but the material is inadequate. See what I say on p. 173.

No. 10,853 is *Rh. spanotrichum*, Balf. f. et W. W. Sm.

No. 11,066 is *Rh. pogonostylum*, Balf. f. et W. W. Sm.

No. 11,067 is *Rh. adenostemonum*, Balf. f. et W. W Sm.

No. 11,067B is fruiting specimen of No. 11,066.

I am indebted to the Director of Kew for the loan of Henry's specimens for examination.

Rhododendron pogonostylum, Balf. f. et W. W. Sm.[1]

Small tree reaching 4–5 m. in height with medium thick branches. Branches a year old dirty grey colour enclosed

[1] *Rhododendron pogonostylum*, Balf f. et W W. Sm.—Arbor parva ad 4·5 m. alta ramis crassiusculis. Ramuli annotini sordide grisei glandulis paucis clavatis rubris nigricantibus breviter stipitatis et pilis plurimis floccosis cinereo-marcidis stratum compactum facientibus induti tandem glabrescentes flavido-virides et glandularum detersilium cicatricibus punctulati. Alabastra ignota. Folia petiolata ad 14 cm. longa, lamina rigide coriacea oblongo-lanceolata vel oblongo-ovata ad 12 cm longa ad 4 5 cm lata apice attenuata acuta nunc subrostrata tuberculo parvo atro-rubente corneo terminata margine cartilaginea leviter recurva undulata et cicatricibus subasperata basi obtusa vel subrotundata supra olivacea vel fulvo-olivacea opaca costa media sulcata sulco pilis floccosis et glandulis paucis marcidis plus minusve impleto venis primariis utrinsecus ad 16 subsulcatis caeteroquin plana evenulosa primo aspectu glabra sed pilorum floccosorum glandularumque vestigiis notata subtus helvola costa media venisque primariis elevatis paullo erubescentibus venularum reti nunc plus minusve prominulo ubique glandularum (an pilorum ?) pedibus rubris punctulata ; petiolus crassiusculus ad 2 cm. longus supra sulcatus strato sordide cinereo pilorum floccosorum marci-

in an indumentum composed of a few clavate red blackening shortly-stalked glands and very many floccose greyish withered hairs, ultimately glabrescent and yellow-green, punctulate with cicatrices of the fallen glands. Foliage buds unknown. Leaves petiolate as much as 14 cm. long; lamina rigid somewhat thickened coriaceous oblong-lanceolate or oblong-ovate as much as 12 cm. long and 4·5 cm. broad narrowed to the acute apex which is sometimes somewhat beaked and ends in a small dark-red horny tubercle, margin cartilaginous slightly recurved and roughened by scars of fallen glands or hairs, base obtuse or somewhat rounded; upper surface olivaceous or

dorum plus minusve vestitus plerumque glabrescens. Flores breviter racemoso-umbellati circ. 8 in quaque inflorescentia rhachi vix 1 cm. longa rufo-floccosa; bracteae fertiles spadiceo-brunneae late oblongo-spathulatae circ. 2·5 cm. longae circ. 1·5 cm. latae apice rotundatae vel subtruncatae saepe mucronatae rufo-ciliatae centro coriaceae margine submembranaceae et ciliatae intus (dimidio infero excepto) extusque dense piloso-sericeae; bracteolae filiformes aurantiacae pedicellis breviores adpresso-pilosae, pedicelli validi ad 8 mm. longi saepe breviores apice obliqui glandulis plurimis rubris longe et breviter stipitatis et pilis sebaceis floccosis paucioribus vestiti. Calyx minutus cupularis circ. 1·5 mm. longus fere ad basim in lobos 5 carnosulos late ovatos fissus ubique extus rubro-glandulosus et pilis sebaceis rufis floccosis copiose obsitus margine glanduloso-ciliatus. Corolla pallide rosea tubuloso-campanulata circ. 4·5 cm. longa saepe minor circ. 3·5 cm. longa extus basi puberula et ad venulas supra glandulis paucis praedita intus puberula et postice atrorubro-maculata evariculata basi 5 gibbosa, 5-lobata, lobis rotundatis emarginatis subcrenulatis in floribus majoribus circ. 1·8 cm. longa et 2·5 cm. lata. Stamina 10 inaequalia in floribus majoribus longiora circ. 3 cm. longa breviora circ. 2 cm. antheris circ. 2 mm. longis, filamentis deorsum expansis a basi ima sursum ultra medium dense pubescentibus eglandulosis Discus glaber. Gynaeceum in floribus majoribus circ. 3·8 cm. longum; ovarium conoideum paullo sulcatum nigrescens circ. 6 mm. longum circ 3 mm. diam. dense floccoso-pilosum pilis albidis vel rufo-sebaceis a basi strictim et adscendentim ramosis glandulas clavatas aurantiacas breviter stipitatas pauciores intermixtas obtegentibus et occludentibus; stylus gracilis ut ovarium pilis et glandulis ex toto dense (vel ad medium laxius) obtectus sub stigmate subspongioso subdiscoideo haud ampliatus. Capsula leviter curvata circ. 4 cm. longa circ. 1 cm. diam. glabrescens nigra indumenti juvenilis collapsi vestigiis plus minusve praedita, calyce cupulari persistente paullo aucto basi cincta, stylo delapso. Semina oblonga complanata circ 3 mm. longa 1 mm. diam. rufo-aurantiaca circumcirca alata et caruncula chalazali albida cristata.

Species *Rh. irrorato*, Franch. affinis sed foliis majoribus oblongo-lanceolatis vel oblongo-ovatis nec oblanceolatis, petioli indumento persistentiore, inflorescentiae rhachi rufo-floccosa, pedicellis vix 1 cm. longis glandulosis et floccosis, calyce glanduloso et floccoso, corolla basi extus puberula, staminum filamentis ad medium vel ultra pubescentibus, ovario et stylo ex toto pilis sebaceis floccosis glandulas occludentibus dense (stylo nunc partim et laxius) vestito distinguenda.

tawny-olive mat with a grooved midrib, the groove being more or less filled with withered floccose hairs and glands, primary veins about 16 pairs slightly sulcate, leaf-surface elsewhere flat veinless at first sight glabrous but marked by the vestiges of the floccose hairs and glands which have fallen; under surface yellowish buff with the midrib and primary veins raised and slightly reddening, network of the veinlets sometimes more or less prominent everywhere punctulate with the red bases of glands (or hairs); petiole thickish about 2 cm long grooved above more or less clad by a dirty grey stratum of withered floccose hairs, commonly glabrescent. Flowers in a short racemose-umbel about 8 in each inflorescence with a rufous floccose rhachis scarcely 1 cm. long; fertile bracts chestnut-brown broadly oblong spathulate about 2·5 cm. long and 1·5 cm. broad rounded or subtruncate at the base often mucronate rufously ciliate, the central part somewhat coriaceous and girt by a somewhat membranous ciliate marginal area, on the inside (except in the lower half) and outside densely pilose sericeous; bracteoles thread-like orange-coloured shorter than the pedicels covered with adpressed hairs, pedicels stout as much as 8 mm. long, often shorter, oblique at the apex, clad with many red both long- and short-stalked glands and fewer greasy floccose hairs. Calyx minute cupular about 1·5 cm. long cut almost to the base into 5 fleshy broadly ovate; lobes everywhere on the outside red glandular and abundantly covered by greasy red floccose hairs, margin of the lobes glandular ciliate. Corolla pink tubular-campanulate 4·5 cm. long often less (about 3·5 cm.), outside at the base puberulous and sprinkled with glands on the veins higher up, inside puberulous and spotted dark red on the back without a blotch, base retuse and 5-gibbous, 5-lobed; lobes rounded emarginate subcrenulate about 1·8 cm. long and 2·5 cm. broad in the larger flowers. Stamens 10 unequal, in the larger flowers the longer ones about 3 cm. long shorter about 2 cm.; anthers about 2 mm. long; filaments expanded towards the base and from there to beyond the middle densely pubescent but eglandular. Disk glabrous. Gynaeceum in the larger flowers about 3·8 cm. long; ovary conoid slightly grooved blackening about 6 mm. long and 3 mm. in diameter densely floccose

with very many white or rufous greasy hairs stiff and branching from the base, these form the upper stratum of indumentum covering a lower one of clavate orange-coloured shortly-stalked glands which are fewer in number than the hairs; style slender and like the ovary covered throughout with hairs and glands (rarely only to the middle and then with fewer hairs and glands); stigma somewhat spongy and somewhat discoid and the style is not much expanded below it. Capsule slightly curved about 4 cm. long and 1 cm. broad glabrescent and black but possessing the remains of the collapsed indumentum of the ovary, girt at the base by the persistent slightly enlarged cupular calyx. Seeds oblong flattened about 3 mm long and 1 mm. broad of a reddish-orange colour winged all round and with a chalazal white crest.

S.E. Yunnan:—Mengtsz. N. mountains, forests. 7000 ft. Tree 15 ft. Flowers pink. Henry. No. 11,066; 8500 ft. Tree 10 ft. Henry. No. 11,067B. In fruit. In Herb. Kew.

This Henryan plant from the S.E. of Yunnan is certainly nearest to *Rh. irroratum*, Franch. in the Irroratum series. It has the rigid leaves with prominently undulate margin of that species, but the leaf-form is somewhat divergent. The lamina is wider below than above the middle, becoming at times somewhat narrowly ovate or oblong ovate with a rounded base. The petioles retain the juvenile indumentum much longer—it may be found upon them until they fall, so that the petiole does not appear so completely glabrous as it does in *Rh. irroratum*. Then the inflorescence rhachis is quite floccose, not purely glandular as in *Rh. irroratum*; the pedicels are usually under 1 cm. long and intensely floccose as well as glandular, as is the calyx—in *Rh. irroratum* there are no flocks. The tubular-campanulate corolla shows a character not seen in others of the Irroratum series—it is puberulous at the base outside, at the same time it has a sprinkling of glands upon the veins as in *Rh. irroratum*. The staminal filaments are pubescent to the middle and beyond not only finely puberulous at the base as in *Rh. irroratum*; they are also eglandular—a distinguishing character from *Rh. adenostemonum*. The ovary is quite covered with branched usually greasy floccose hairs so densely that an underlying layer of clavate

glands is entirely concealed, and this indumentum extends typically to the top of the style, a condition very different from the purely red-glandular ovary and style of *Rh. irroratum*. In one flower I found the indumentum of the style extending only half-way up it, and the densely bearded character was hardly developed, the flocks and glands being fewer and distant.

Rh. adenostemonum is an ally, but there we have a more purely glandular type, wanting the very pronounced flocks on the style, having neither glands nor hairs on the outside of the corolla and showing glands on the staminal filaments.

The two specimens in the Kew Herbarium—one in flower, one in fruit—are the only ones I know of.

Rhododendron spanotrichum, Balf. f. et W. W. Sm.[1]

A small tree reaching about 6 m. in height. Branches not very thick. Branches a year old as much as 3 mm. in

[1] *Rhododendron spanotrichum*, Balf. f. et W. W. Sm.—Arbor parva ad 6 m. alta ramis haud crassis. Ramuli annotini ad 3 mm. diam. pallide virides glabri glandularum (an floccorum ?) detersarum pedibus rubris tandem nigricantibus minute punctulati. Alabastrorum oblongo-ovoideorum obtusorum circ. 5 mm diam. perulae plus minusve viscidae glandulis rubris sessilibus extus praeditae exteriores parvae semi-lunatae et rotundatae circ. 3 mm. longae et latae crustaceo-coriaceae brunneae intus basi apiceque adpresso-puberulae margine minute glanduloso-fimbriatae vel breviter glanduloso-pilosae interiores oblongo-ovatae vel oblongo-ellipticae obtusae viscidae. Folia petiolata ad 13·5 cm. longa; lamina coriacea oblanceolata ad 12 cm. longa ad 4 cm. lata apice subrostratim attenuata vel breviter acuminata mucronulata margine cartilaginea obscure undulata subplana cicatricibus glandularum (an pilorum ?) detersarum subasperata basi obtusa vel late cuneata saepe inaequalis supra pallide vel atro-olivacea saepe brunnescens opaca haud nitens costa media sulcata venis primariis utrinsecus circ. ad 18 inconspicue sulcatis caeteroquin laevis glaberrima sed glandularum detersarum pedibus vestigialibus minute rubro-punctulata subtus helvola vel rubro-brunnea subnitens costa media venisque primariis leviter erubescentibus conspicue elevatis venularum reti paullo eminente ubique primo aspectu glabra sed glandularum detersarum pedibus vestigialibus rubro-punctulata; petiolus ad 1·5 cm. longus crassus supra sulcatus erubescens glabrescens ut lamina rubro-punctulatus. Flores racemoso-umbellati circ. 10 in quaque inflorescentia rhachi circ. 1·8 cm. longa glabra; bracteae extimae steriles ovatae vel subrotundatae crasso-coriaceae margine tenuiores extus pubescentes vel subsericeae et sparsissime apicem versus rubro-glandulosae fertiles obovato-spathulatae apice truncatae vel rotundatae mucronatae ad 2·6 cm. longae ad 1·6 cm. latae extus dense et grosse adpresso-pilosae; bracteolae filiformes rubiginosae circ. 1·5 cm. longae pedicellis multo longiores sericeo-pilosae; pedicelli circ. 7 mm. longi crassi pilis floccosis sebaceis rufis plus minusve praediti. Calyx minutus

diameter pale green glabrous minutely punctulate with the red (finally blackening) bases of fallen glands (or flocks). Scale-leaves of the oblong ovoid obtuse about 5 mm. in diameter foliage-leaf buds more or less viscid and furnished with red sessile glands; outer scale-leaves small semi-lunate and rounded about 3 mm. long and broad crustaceously coriaceous, brown, inside at the base and apex adpressed puberulous, margin minutely gland-fimbriate or shortly gland-pilose; inner scale-leaves oblong-ovate or oblong-elliptic obtuse viscid. Leaves petiolate as much as 13·5 cm. long; lamina coriaceous or thickly chartaceous oblanceolate as much as 12 cm. long and 4 cm. broad narrowed to the somewhat beaked or shortly acuminate apex, mucronulate, margin cartilaginous obscurely undulate somewhat flat slightly roughened by the cicatrices of fallen glands, base obtuse or widely cuneate often unequal; upper surface pale or dark olive-green often becoming brown, mat not glossy with a grooved midrib, the primary veins about 18 pairs inconspicuously grooved, the rest of the surface smooth very glabrous but minutely red-punctulate from the persistent bases of fallen glands; under surface yellowish-buff or greyish-brown or reddish-brown somewhat glossy, the midrib and primary veins slightly reddening and conspicuously raised, the network of the veinlets slightly raised, everywhere at first sight glabrous but punctulate with the red bases of fallen glands: petiole as much as 1·5 cm. long thick sulcate above, reddening glabrescent, red-punctulate like the lamina. Flowers racemose-umbellate about 10 in each inflorescence the axis about 1·8 cm. long glabrous;

circ. 1·5 mm. longus cupularis glaber vel pilis sebaceis rufis floccosis paucis conspersus, lobis vix conspicuis deltoideis vel ovatis efimbriatis. Corolla kermesina campanulata circ. 4·5 cm. longa extus intusque glabra postice varo magno atro-kermesino notata emaculata 5-retuso-gibbosa 5-lobata, lobis circ. 2 cm longis circ. 2·5 cm. latis subellipticis vel rotundatis emarginatis subcrenulatis. Stamina 10 inaequalia longiora circ. 3·6 cm longa antheris circ. 4 mm. longis breviora 1·6 cm. longa antheris circ. 3 mm. longis, filamentis basi dilatatis glabris. Discus glaber. Gynaeceum circ 3·6 cm. longum; ovarium conoideum leviter sulcatum nigrescens obscure transverse areolatum circ. 5 mm. longum pilis sebaceis rubris floccosis sparsissime conspersum; stylus glaber sub stigmate lobulato purpureo vix ampliatus.

Species *Rh. gymnantho*, Diels affinis sed foliis brevioribus et latioribus supra opacis, inflorescentiae rhachi glabra, calycis lobis efimbriatis, corolla campanulata, staminum filamentis glabris, ovario sparsissime flocoso distinguenda.

outer sterile bracts ovate or somewhat rounded thick and coriaceous thinner at the margin, outside pubescent or somewhat sericeous and at the apex sparingly red-glandular; fertile bracts obovate-spathulate truncate or rounded and mucronate at the apex as much as 2·6 cm. long 1·6 cm. broad outside densely and coarsely adpressed-pilose; bracteoles filiform rusty-red about 1·5 cm. long much longer than the pedicels and silkily hairy; pedicels about 7 mm. long thick furnished more or less with rufous greasy floccose hairs. Calyx minute about 1·5 mm. long cupular glabrous or sprinkled with a few greasy rufous floccose hairs; lobes scarcely conspicuous deltoid or ovate efimbriate. Corolla crimson campanulate about 4·5 cm. long glabrous outside and inside with a large dark crimsom blotch at the back without any spots, at the base 5-gibbous and retuse, 5-lobed; lobes about 2 cm. long and 2·5 cm. broad, somewhat elliptic or rounded emarginate and somewhat crenulate. Stamens 10 unequal the longer about 3·6 cm. long with anthers about 4 mm. long, the shorter about 1·6 cm. long with anthers about 3 mm. long; filaments dilated at the base and glabrous. Disk glabrous. Gynaeceum about 3·6 cm. long, ovary conoid slightly sulcate blackening obscurely and transversely areolate about 5 mm. long most sparingly sprinked with greasy red floccose hairs; style glabrous scarcely expanded under the purple lobulate stigma.

S.E. Yunnan:—Fengchenlin Mountains. 7500 ft. Tree 20 ft. Flowers crimson. Henry. No. 10,853. Herb. Edin. et Kew.

Rh. spanotrichum is one of the Henryan plants from the region of Mengtsz, formerly regarded by Hemsley and Wilson[1] as *Rh. irroratum*, Franch. They point out, however, that it differs "from typical *Rh. irroratum* in the filaments and ovary being glabrous or nearly so." Subsequently Rehder and Wilson[2] brought it more correctly to the vicinity of *Rh. gymnanthum*, Diels. See under *Rh. mengtszense*, p. 209.

The plant is neither *Rh. gymnanthum* nor *Rh. irroratum*. It has in some measure the glaucousness of foliage that

[1] In Kew Bulletin (1910), 112.
[2] Plantae Wilsonianae, i (1913), 539.

marks *Rh. irroratum*, but the oblanceolate form of the leaf is much more marked here and the tip is more definitely beaked or shortly acuminate. Then the flowers are red not white or yellow-white tinged with rose as in *Rh. irroratum*, the inflorescence rhachis is glabrous not glandular, the pedicels are under not over 1 cm. long, the calyx is glabrous or sparingly floccose not glandular, the campanulate corolla (not tubular-campanulate) has no glands on the outside and is glabrous not hairy inside, the staminal filaments are glabrous not finely puberulous at base, the ovary is very sparingly floccose not densely glandular, and the style is glabrous not glandular.

The relationship to *Rh. gymnanthum* is closer than to *Rh. irroratum*, and the species is a distinct member of that set within the Irroratum series which are grouped under Gymnanthum. See p. 171, where diagnostic characters are given.

Rhododendron tanastylum, Balf. f. et Ward.[1]

A medium-sized scraggy bush or more generally a thin tree of about 6 m. in height living well inside the rain-

[1] *Rhododendron tanastylum*, Balf. f. et Ward.—Arbor tenuis ad 6 m. alta vel frutex macer, silvarum pluvialium incola, ramis tenuibus. Ramuli annotini circ. 1·5 mm. diam. pilis floccosis albidis plus minusve induti glabrescentes tandem rubro-purpurei punctulati dein sordide grisei decorticantes. Alabastra matura foliorum ignota. Folia petiolata ad 13·5 cm. longa; lamina chartacea late lanceolata vel oblanceolata ad 12 cm. longa ad 4·3 cm. lata apice attenuata nunc breviter subacuminata nunc obtusa subrostrata tuberculo corneo parvo terminata margine cartilaginea recurvata undulata cicatricibus obscure subasperata basi obtusa vel subcuneata supra olivacea vel brunneo-olivacea opaca costa media sulcata sulco pilorum vestigiis plus minusve praedito venis primariis utrinsecus circ. 16 et venularum reti inconspicuis caeteroquin laevis glabra sed floccorum juvenilium vestigiis obscure notata, subtus pallidior saepe fulva subnitens costa media erubescente et venis primariis elevatis pedibus rubris floccorum (an glandularum ?) detersorum punctulatis caeteroquin glabra; petiolus ad 1·5 cm. longus saepius brevior crassus rubro-purpureus supra sulcatus plus minusve floccosus sed glabrescens. Flores racemoso-umbellati circ. 8 in quaque inflorescentia rhachi tenui ad 2 cm. longa furfuracea; bracteae deciduae ignotae; bracteolae filiformes rufescentes circ. 8 mm. longae pedicellis breviores sericeo-pilosae; pedicelli ad 1 cm. longi validi atro-purpurei pilis floccosis brevibus sparsissime conspersi vel glabri. Calyx minutus cupularis carnosulus circ. 2 mm. longus cupula glabra, lobis 5 late ovatis extus glabris margine pilis sebaceis sparsim ciliatis. Corolla intense kermesina tubuloso-campanulata ad 4·5 cm. longa 5-gibbosa retusa extus eglandulosa epilosa intus glabra et postice varo maculisque pluribus notata 5-lobata, lobis rotundatis emarginatis subcrenulatis circ. 1·7 cm.

forest. Branches slender. Branchlets a year old about 1·5 mm. in diameter clad more or less with white floccose hairs glabrescent ultimately becoming reddish-purple and punctulate; then dirty grey and shedding the bark. Mature buds of foliage-leaves unknown Leaves petiolate as much as 13·5 cm. long; lamina papery broadly lanceolate or oblanceolate as much as 12 cm. long and 4·3 cm. broad, narrowed to the apex and sometimes shortly acuminate sometimes obtuse and somewhat beaked terminated by a small horny tubercle, margin cartilaginous recurved undulate somewhat roughened by the scars of fallen appendages, obtuse or subcuneate at the base; upper surface olivaceous or brown-olivaceous mat, midrib grooved, the groove more or less lined by vestiges of hairs, primary veins about 16 pairs, the ultimate reticulation of the veinlets inconspicuous, the whole surface smooth and apparently glabrous but obscurely marked by the vestiges of young flocks; under surface paler often tawny somewhat glossy, the reddening midrib and the primary veins raised punctulate by the red bases of fallen flocks (or glands ?) rest of the surface glabrous; petiole as much as 1·5 cm. long more often shorter thick reddish-purple grooved above more or less floccose but glabrescent. Flowers racemose-umbellate about 8 in each inflorescence which has a slender scurfy rhachis reaching 2 cm. long; bracts deciduous unknown; bracteoles filiform rufescent about 8 mm. long shorter than the pedicels silkily hairy; pedicels about 1 cm. long stoutish blackish-purple most sparingly sprinkled with short floccose hairs or glabrous. Calyx minute cupular fleshy about 2 mm. long, the cup glabrous; lobes 5 broadly ovate glabrous outside, margin sparingly ciliate with greasy hairs. Corolla crimson

longis circ. 2 cm. latis Stamina 10 inaequalia longiora circ. 3 cm. longa breviora circ. 1·5 cm. longa corolla styloque multo breviora antheris circ. 2·5 mm. longis, filamentis basi vix latioribus glabris. Discus glaber. Gynaeceum ad 4·2 cm. longum corolla paullo brevius; ovarium circ 7 mm. longum cylindricum glabrum nigrescens leviter sulcatum obscure papillato tuberculatum; stylus longus stamina longe superans glaber in stigma purpurascens lobulatum paullo ampliatus

Species *Rh. arizelophyllo*, Balf. f. et W. W. Sm. proxima foliis latioribus subtus punctulatis, pedicellis (sub 1 cm.) multo minoribus, inflorescentiae rhachi furfuracea, corolla intense kermesina tubuloso-campanulata quadrante majore, staminum filamentis glaberrimis, ovario glabro, stylo longo fere corollam aequante facile recognoscenda.

tubular-campanulate as much as 4·5 cm. long, at the base 5-gibbous and retuse, outside glandless and hairless, inside glabrous and marked on the back by a blotch and many spots, 5-lobed; lobes rounded emarginate subcrenulate about 1·7 cm. long and 2 cm. broad. Stamens 10 unequal the longer about 3 cm. long the shorter about 1·5 cm. long, much shorter than the corolla and style; anthers about 2·5 mm. long; filaments scarcely widened at the base glabrous. Disk glabrous. Gynaeceum as much as 4·2 cm. long very slightly shorter than the corolla; ovary cylindric about 7 mm. long blackening glabrous slightly grooved obscurely papillate and tuberculate: style glabrous long far exceeding the stamens slightly expanding into the purple lobulate stigma.

E. Upper Burma:—Hpimaw. 9000–10,000 ft. Medium-sized scraggy bush or more generally thin tree of 20 ft., well inside rain-forest Flowers crimson. F. Kingdon Ward. No. 1566. 19.5.14.

This species is the only one known outside Yunnan of the Irroratum series, and it is most like *Rh. araiophyllum*, Balf. f. et W. W. Sm. of the Shweli-Salween divide—the species of the series nearest to it geographically. With *Rh. araiophyllum* it differs from some others of the Irroratum series in its very thin twigs, in the general absence of glands, and in the smaller flower-truss with thin axis It is readily told from *Rh. araiophyllum*, the under-leaf surface in which is not punctulate and which has also longer pedicels, a hairy rhachis to the inflorescence, an openly campanulate smaller white corolla, pubescent staminal filaments, a puberulous ovary, and a style hardly longer than the stamens.

Our species falls, as I have pointed out above (see p. 171) into the set of Gymnanthum. When describing *Rh. araiophyllum* (see p. 186), I said that its relationships to *Rh. gymnanthum*, Diels must not be overlooked. The relationships of *Rh. tanastylum* to *Rh. gymnanthum* are nearer, yet the two plants are not the same species. Foliage and habit characters distinguish them at once. If we knew enough we might be able to correlate these with habitats —*Rh. gymnanthum* a plant of "open rocky situations," *Rh. tanastylum* from "well within the rain forest." In

Rh. gymnanthum, which Forrest describes as a "shrub of 3–6 ft.," the leaves are long (as much as 19 cm.) narrowly (in the longest leaves some 3·5 cm. broad) lanceolate and willow-like, with a slight curvature in the direction of sickle shape, and the upper surface is glaucous green conspicuously glossy. In *Rh. tanastylum*, which Ward speaks of as a "medium-sized scraggy bush or more generally thin tree of 20 ft.," the leaves do not show a length beyond 13·5 cm. and their width is 4·3 cm.; they are therefore much shorter, their width is greater in relation to their length, and their general form runs from lanceolate and broadly lanceolate to lanceolate oval sometimes oblanceolate oval, and there is no curvature; their upper surface is dark olive-green or brownish-olive and the under surface is darker. The leaf margin in *Rh. gymnanthum* is nearly flat and its undulations are not conspicuously developed, but in *Rh. tanastylum* the margin is prominently recurved and the undulations give an appearance of crenulation. In the flower region the inflorescence-rhachis becomes glabrous and smooth in *Rh. gymnanthum* but may retain a few floccose hairs; in *Rh. tanastylum* it develops a curious furfuraceous surface, giving the impression of very minute puberulousness. The pedicels in *Rh. gymnanthum* are more slender; its corolla is funnel-shaped campanulate not tubular-campanulate and is somewhat shorter; the staminal filaments are puberulous. Our specimens of both plants are scanty and have neither foliage nor flower-buds nor yet fruits, and the flower material of *Rh. tanastylum* is particularly small in amount. What we have suffices to distinguish the species, although it is inadequate for their complete description.

Since this paper was read and printed, additional species of the Irroratum section have become known. They are:—

Rh. eriogynum, Balf. f. et Ward.	E. Upper Burma	Fen-Shin-Ling Camp. 8000–9000 ft. (Ward.)
Rh. facetum, Balf. f. et W. W. Sm.	Mid. W. Yunnan.	Ghi Shan, E. of Tali Lake. 9000 ft. (Forrest.)

Specimens of *Rh. Kendrickii*, Nutt., collected by R. E. Cooper in Bhutan, which I have examined, tell me that its affinity is with the Irroratum series and not with *Rh. arboreum*, Sm.

Observations on Rhododendron Seedlings.

By Professor Bayley Balfour, F.R.S.

(Read 12th April 1917.)

But little information is to be found in botanical books about the seedlings of Rhododendrons. Lord Avebury in his book On Seedlings mentions one species only—*Rh. arboreum*. We have at present in the Royal Botanic Garden an assemblage of Rhododendron seedlings more varied perhaps than is to be found elsewhere, and upon this what I am to say is based. Whilst the earliest stages of extraseminal development are uniform in the genus, the features of the epicotyl through its juvenile stages show divergences, which we may in time be able to correlate with both phyletic and œcologic factors. In this record of observations I have specially in view to point out characters of transition that appear in the seedlings of species which, as adults, possess an underleaf-indumentum conveniently termed tomentose in the loose terminology of systematic description.

My attention was first focussed upon the phenomenon I am about to mention by finding that plantlets raised from seed—of the correct naming of which there was no room for doubt—did not show, even in a fifth year of growth in some cases, the technical character of leaf-indumentum which belonged to the species at maturity. That the assumption of adult form by a plantlet may be long delayed is now a commonplace of botanical teaching, to be illustrated by examples from the most diverse families of plants, and reaching even the stage of a permanent juvenility, but I had no knowledge of its occurrence amongst Rhododendrons, nor indeed amongst Ericaceae.

In the seedlings to which I am referring the foliage-leaves of the early years of growth—which in the matter of shape may be rightly described as miniature of the adult —have the undersurface coloured an intense, often very dark, red due to the presence of anthocyanin pigment, which develops not only in the epidermis, but also in the mesophyll. Commonly too the surface is sprinkled with capitate

stalked glands, and may be really sticky. As the shoot ascends and years pass—the number varies much and is doubtless affected by the environment—the redness on new leaves lessens, and even to the extent that the underleaf may be quite green. Then comes the stage when the indumentum begins to appear on the new leaves, starting frequently from about and around the midrib, not forming a complete coating, so that leaves with indumentum in varying amount on a green surface, blotched as it were by it, may be found in years preceding the formation of leaves with a complete indumental layer. In some cases there may be an abrupt passage from the surface without tomentum to the leaf with full tomentum. In others the leaf, without becoming green beneath, may form a blotched or complete indumentum atop the reddened underleaf surface. The glands if present on the young leaf may be developed under the indumentum on the old or may be absent.

My observations are as yet too few and unsystematised to permit of the framing of a classification of species according to the resemblances and differences they exhibit in the character. Nor am I able, in the present nebulous state of phyletic grouping in the genus, to say in what degree the character has importance as a mark of relation. All I propose to do here is to name some illustrative examples of species in which I have observed the feature under consideration.

Rh. adenogynum, Diels, supplies one of the most striking examples of these juvenile stages. The red glandular undersurface of the young leaves is most conspicuous. The redness disappears entirely in the leaves of about the third year, which are quite green below and do not form glands or hairs save perhaps a few sebaceous flocks on the midrib. Then after some seven years the buff-coloured tomentum, composed of dendriform long hairs with interwoven branches, begins to show at the base of the leaf. No one would suppose the young plant in these early stages of its life was really *Rh. adenogynum*. Another interesting point may be noted. This species branches from the base of the stem at a very early period

and the first leaves of the branchlets at ground surface have the underside red.

Rh. arboreum, Wall. and its Chinese representative *Rh. Delavayi*, Franch. show the reddening of the juvenile leaf-undersurface and then pass through a green stage. When the indumentum begins to develop it appears along the midrib and spreads out along the primary veins, but does not at first reach the leaf-margin, so that the leaf has a green border around the median grey-coloured indumentum.

Rh. argenteum, Hook. f. has a deep purple glandular undersurface to the early juvenile leaves. Most commonly in the seedlings which I have seen the following leaves are green underneath before development of those with characteristic tomentose indumentum of adpressed rosettes of vesicular hairs appearing simultaneously over the whole surface. In some, however, the red surface remains and the indumentum appears in a blotched fashion upon the surface.

Rh. bullatum, Franch. begins with leaves showing an intensely red undersurface which is also lepidote, with yellowish peltate discontiguous scales, and has a few straight hair-bristles. By the sixth year the red surface appears less conspicuous, being covered by a dense tomentum of amber-brown interwoven hairs which conceals the peltate scales.

Rh. campanulatum, Wall. supplies a typical example of the red glandular undersurface of the juvenile leaf, and the tomentum appears simultaneously over the whole surface, usually in the leaves of about the third year. But I have seen some leaves with blotched indumentum and some in an intermediate stage with a nearly green undersurface.

Rh. Clementinae, G. Forrest is a striking species in the adult state, with its thick white indumentum on the leaf-undersurface. Three-year-old seedlings show no trace of it, and the leaves still have an intensely red undersurface with glands and a few hair-flocks on midrib and at margin. Later stages I do not know.

Rh. dichroanthum, Diels.—Here the juvenile underleaf-surface is deep red.

Rh. Falconeri, Hook. f.—The transition to the adult chalice-hair of the superstratum of the indumentum appears to be early, and is often abrupt, but beautiful blotched states often are seen.

Rh. fictolacteum, Balf. f. has leaves with red and glandular undersurface until its third year, at which stage apparently all the leaves develop the characteristic buff tomentum.

Rh. haematodes, Franch., in which the adult leaves show a dense tawny tomentum, has the juvenile leaf black-purple and glandular beneath.

Rh. Hodgsoni, Hook. f.—The seedlings which I have seen pass through a stage in which the underleaf surface loses much of its red colour, without, however, becoming actually green, before the characteristic tomentum appears.

Rh. lacteum, Franch. shows leaves with green undersurface between the early ones, which have particularly intense red and glandular surface, and the mature leaves with dark tawny somewhat velvety tomentum of stalked rosette hairs. The same transition seems to characterise other species of its series, for instance, *Rh. Beesianum*, Diels, *Rh. fulvum*, Balf. f. et W. W. Sm., *Rh. Traillianum*, G. Forrest.

Rh. niphargum, Balf. f. et W. W. Sm. has a snow-white bistrate indumentum on the undersurface of the old leaves. The juvenile ones are brilliant scarlet beneath, coated with glands secreting a very viscid mucilage. What form the transition to the tomentose condition takes I do not know. Our seedlings three years old show only a slight lessening in intensity of the redness, but no development of indumentum.

Rh. Roxieanum, G. Forrest.—The juvenile leaves are not very glandular on the deep red undersurface, and evidently pass through a green stage before developing indumentum, which has not yet appeared on our three-year-old seedlings.

Rh. sinogrande, Balf. f. et W. W. Sm. shows states resembling those of *Rh. argenteum*, Wall.

Rh. taliense, Franch. has juvenile leaves which appear to pass always through a stage of gradual lessening of redness on the underside without becoming really green, but none of our seedlings, now some six or seven years

old, show as yet any of the thick buff indumentum of the adult.

The illustrations I have named show that the development of anthocyanin pigment in the leaves of the juvenile state is associated with varied forms of hairy indumentum in the leaves of the adult. The history of the transition in the several species remains to be traced. In many species scattered sebaceous floccose hairs appear on the veins before the coating becomes a true tomentum. I may add that in *Rh. Anthopogon*, David Don, in which the adult leaves have a lepidote indumentum, there is reddening of the undersurface in the juvenile leaves.

The facts suggest that there is here a change of construction in relation to a change in climatic relation. The plantlet passes from a position in which its functioning foliage is subject to all the conditions of light, moisture, heat, and air-current, belonging to a stratum at the soil-surface, to one some distance above the soil-surface, in which the same external influencing factors operate in different co-ordination and intensity. Temperature and speeding up of metabolism are prime considerations in the one environment, control of transpiration in the other. The anthocyanin development is an adaptation to the former, the indumentum to the latter. Material devoted to the making of relatively unstable cell-pigments in the early phases of ontogeny is now used for the building of tissues—what a complex laboratory it is!—and perhaps there is special significance in the fact of the indumentum-formation so often beginning at and about the midrib and leaf-base. It certainly secures first attention to the formation of the indumentum hairs.

This anthocyanin formation on the undersurface of leaves is not unknown elsewhere. Text-books record it particularly in plants of woods and like-shaded areas, and observers have pointed out that the coloration is rare in plants which are woolly or have otherwise constructed hair-coverings. Here, in those Rhododendron seedlings, we have the states combined, and the seedlings appear to offer particularly favourable objects for experimental work bearing upon the functions performed by anthocyanin pigments.

Botanists are far from agreed upon this subject of anthocyanin, and conclusions based upon the same set of experiments are sometimes diametrically opposed. In part the conflict of opinion seems to be due to the tendency of workers to see in one activity the only significance of the pigment. As I read the facts of distribution of anthocyanin in Nature, and those of experimental work, I receive the impression that these pigments, having a definite absorptive relation to light and to heat—whatever else they may do,—may operate differently in accordance with the position in which they occur.

Their occurrence in the young unfolding leaves of the bud, particularly in tropical and warm-country trees, is the starting-point for the suggestion of their use as a screen to the chloroplasts against intense insolation; and if to the chloroplasts also to the cytoplasm, whether chloroplasts be present in an organ or are absent, as in the case of the anther. Much experimental work has been carried out to test this hypothesis, which I believe is well founded. It is obviously difficult to apply this interpretation to our Rhododendron seedlings where the pigments are on the under and concealed surface of the leaves, which are not in danger of intense insolation.

The frequent abundance of anthocyanin pigments on leaf-petioles, on stems, on veins, has been advanced in support of the suggestion that they have relation to transport of plastic material; their activity would be that of protecting enzymes from harmful solar rays, and thus aiding metabolism and food-transference. This view is, after all, complementary of the other. There is nothing antagonistic. A screen to the cytoplasm itself against intensity of light rays may well be one also to its products against rays of particular quality. In the case of our Rhododendron seedlings such activity of the pigments in relation to the limited amount of light reaching the leaves is quite possible.

Then there is the heat-relation of the pigments. That a light-relation is not the only one is clearly shown by their presence at the root-tips deep in the soil of so many peat plants. Are they not to be regarded as heat-regulators within the plant? Such a conception by no means negates

the light-screen hypothesis. The two activities are not incompatible. Experiment has shown that reddened leaves have a higher temperature than green leaves. This surely means greater protoplasmic activity in all directions; and whilst to some observers the promotion of transpiration is the primary value to the plant of a heat-relation, to others it is the increased metabolism itself. Is there any reason for disallowing either effect at the several times which favour the respective functions? On the other hand, to some observers the heat-relation of the anthocyanin is solely that of a heat-screen.

The circumstances of our Rhododendron seedlings seem to point to this heat-activity of anthocyanin as important in their case, for light-poverty and radiation-cold are factors not conducive to copious food-formation, and the profuse root-system and large hydathodes of the seedlings suggest a very free water-current. Heat-accession through anthocyanin may well be an aid here.

Not all Rhododendron seedlings show the red pigmentation of the undersurface in juvenile leaves. *Rh. auriculatum*, Franch. is a species in which the adult leaves have a loose underleaf tomentum, and I do not find in the juvenile leaves the red coloration. In species, too, like *Rh glaucum*, Hook. f., *Rh. hippophaeoides*, Balf. f. et W. W. Sm., *Rh. oleifolium*, Franch., and others, where the adult leaves are lepidote and covered beneath by a wax coating giving them a white or bright grey colour, I have not seen the pigmentation—the leaves have a wax coating through the juvenile life of the plant.

On the other hand, the anthocyanin appears in juvenile leaves of species which do not develop on the leaves of the adult any marked indumentum. Species of the Thomsoni Series—using that term comprehensively to include the Campylocarpum Series and the Selense Series—show this markedly. In them there is a well-developed layer of epidermal papillae forming wax.

These variations point to the value of the seedlings of Rhododendron for a comparative physiological investigation which I believe would throw much light upon the much-discussed problem—the uses of anthocyanin pigments.[1]

[1] See Wheldale, The Anthocyanin Pigments of Plants.

Bulbophyllum Imogeniae: a New Orchid from Nigeria. By Kenneth Hamilton

(Read 8th February 1917.)

The following is a short note on two orchids collected by me in Nigeria which were forwarded to the Royal Botanic Garden, Edinburgh, and flowered there. Both have proved to be new. The first, *Polystachya Hamiltonii*, W. W. Sm., was described in 1915, but I give below a more precise record of the locality. Of the second a description is given below. Types of both species are preserved in the Herbarium of the Royal Botanic Garden, Edinburgh.

Bulbophyllum Imogeniae, K. Ham. Sp. nov.

Species affinis *B. recurvo*, Lindl., *B. viridi*, Rolfe, et *B. Winkleri*, Schltr.; inflorescentia 1 cm. paulo superante oblongo-globosa densiflora, sepalibus ± 4 mm. longis parte superiore roseo-suffusis inter alia conspicua; flores majores quam ei *B. Winkleri*, quod ex descriptione proximum esse videtur.

Planta epiphytica, rhizoma teres glabrum pseudobulbis approximatis obsessum; pseudobulbi ovoidei compressiusculi obscure quadrangulati usque ad 3 cm. longi, 2–2·5 cm. lati, unifoliati, raro bifoliati. Folia 5–10 cm. longa, 1–2 cm. lata, patentia, oblongo-lanceolata acuta, basi cuneata vel subrotundata, coriacea glabra. Pedunculi deflexi 2–4 cm. longi (in planta duos annos culta) medio bractea lata ornati; inflorescentia 1 cm. paulo superans, ± 1 cm. lata oblongo-globosa densiflora, bracteae patentes oblanceolatae vel obovatae translucenti-membranaceae 2–3 mm. longae. Flores parvuli. Sepala aequilonga minute apiculata circ. 4 mm. longa carnosula glabra infra albido-membranacea supra roseo-suffusa; intermedium triangulari-lanceolatum, lateralia valde obliqua falcata, basi margine anteriore dilatata connata. Petala sepalis ± duplo breviora oblonga obtusa vix vel brevissime apiculata tenuiter membranacea integra glabra. Labellum curvatum linguiforme obtusum carnosulum ± 1·5 mm. longum purpureum marginibus minute purpureo-pilosulum. Columna brevis brachiis

lineari-falcatis acutis. Anthera cucullata glabra; ovarium vix pedicellatum glabrum ± 2 mm. longum.

Nigeria:—In the valleys of the mountains north of the Katsena River, North Nigeria, approx. lat. 7° N., long. 10° E. Collected in 1913 and flowered in the Royal Botanic Garden, Edinburgh, October 1915. The small flowers have the sepals tinted a beautiful rose and are themselves in a compact subglobular spike not unlike that of certain Polygonums. The affinity seems to be near *B. recurvum*, Lindl. (Bot. Reg. 963, under *Tribrachia pendula*) and near *B. Winkleri*, Schltr. from the Cameroons. The specific name is in honour of Miss Imogen Ramsay of Bamff.

The locality of *Polystachya Hamiltonii*, W. W. Sm. (Notes R.B.G. Edin., viii (1915), 347), which was stated somewhat indefinitely at the time of the description, is approximately lat. 7° 25′ N., long. 8° 30′ E., in the valley of the Benue River. This orchid has an inflorescence somewhat more branched and certainly with more flowers than indicated in the original diagnosis.

TRANSACTIONS

OF THE

BOTANICAL SOCIETY OF EDINBURGH.

SESSION LXXXII.

Some New Species of Primula which have Flowered Recently. By Professor Bayley Balfour, F.R.S.

(Read 13th December 1917.)

The species described here are:—

P. chrysopa, Balf. f. et Forrest.	Yunnan.	(Forrest.)
P. Harroviana, Balf. f. et Cooper.	Bhutan.	(Cooper.)
P. Hopeana, Balf. f. et Cooper.	Bhutan.	(Cooper.)
P. Maclareni, Balf. f.	Korea.	(Maclaren.)
P. rupestris, Balf. f. et Farrer.	Kansu.	(Farrer and Purdom.)
P. scopulorum, Balf. f. et Farrer.	Kansu.	(Farrer and Purdom.)

Primula chrysopa, Balf. f. et Forrest.[1]

A tufted marsh-loving perennial more or less whitely mealy with a slender rootstock rooting freely and emitting many short stolons. Leaves with long petioles as much as 13 cm. long, ascending; lamina somewhat fleshy concave in the middle above recurving at the sides oblong-elliptic or sometimes elliptic as much as 3 cm. long and 1·5 cm.

[1] *Primula chrysopa*, Balf. f. et Forrest.—Caespitosa plus minusve albo-farinosa stolones breves emittens. Folia longe petiolata ad 13 cm longa ascendentia; lamina oblongo-elliptica circ. 3 cm. longa 1·5 cm. lata circumcirca dentata margine minute glanduloso-ciliata in petiolum abrupte cuneatim contracta utrinque pilis farinferis pulverulenta. Scapus ad 25 cm. altus cum bracteis pedicellisque albo-farinosus umbellam 2–4-floram solitariam gerens nunc verticillo infra praeditus. Flores fragrantes nutantes. Calyx late fusiformis angulatus, lobis conniventibus. Corolla pallide lilacina aureo-oculata extus albo farinosa ore strumis cincta, lobis latis obcordatis imbricatis bifidis. Stamina floris brevistyli ad os corollinum inserta. Stylus brevis calyce paullo longior.
Species *P. gemmiferae*, Batal. affinis foliis longius petiolatis albo-farinosis, corolla extus albo-farinosa inter notas alias distinguenda

broad, dentate all round, the teeth often denticulate ending in a horny hydathode and most minutely gland-ciliate, base more or less wedge-shaped and abruptly contracted into the long petiole, upper surface bright green smooth the mid-rib conspicuously grooved primary veins few sunk in the lamina ascending, under surface pale green the mid-rib whitish and with primary veins prominent, on both surfaces powdered with stalked meal-forming glands; petiole as much as 10 cm. long narrow scarcely winged slightly expanded at base clad with meal-forming glands. Scape as much as 25 cm. high (lengthening somewhat in fruit) slender and like the bracts and pedicels coated with white meal, bearing a terminal 2–4-flowered umbel and sometimes a 2–4-flowered whorl below it; bracts erect adpressed about 5 mm. long green or purpling involucrate oblong narrowed to the obtuse apex slightly keeled, at the base slightly thickened not spurred; pedicels varying in length longest as much as 4 cm. long, those of the lower whorl shortest, straight and erect below nodding at the top; anthopode about 1 mm. long white farinose. Flowers fragrant. Calyx green or more or less purple as much as 5 mm. long whitely mealy both outside and inside broadly fusiform 5-grooved split to the middle into 5 connivent lobes. Corolla pale lilac with golden eye, oblique, expanded vertically; tube of the short-styled flower about 1·5 cm. long straw-coloured cylindric swollen and deeper coloured above the insertion of stamens more or less mealy outside, rugulose inside, at the throat encircled by orange-coloured puberulous pouchings (as many as 15) which hardly form an annulus; limb somewhat reflexed with a disk about 1·5 mm. broad and 5 broad obcordate imbricate bifid lobes about 6 mm. long more or less crenulate, puberulous towards the base above, more or less farinose beneath. Stamens in short-styled flower inserted close to mouth of corolla-tube; filaments conspicuous not expanded at base straw-coloured; anthers about 2 mm. long not crested but with slightly hairy whitish connective, scarcely protruding from corolla-tube. Ovary broadly globose green; short style pale green longer than the calyx; stigma green capitate and depressed. Capsule cylindric about 1 cm. long and 3 mm. in diameter without a stylopod, lower part included in calyx, crustaceous

upper part naked thickened and dehiscing from its top to the mouth of the calyx-tube by 5 short valves; placenta cylindric about 4 mm. long with a stout stalk about 1 mm. long. Seeds pale tawny oblong flattened, the testa minutely tuberculate winged all round by a many-celled membranous aril, 0·75 mm. long, with the aril 1·5 mm. long.

E.N.E. Yunnan:—Bei-ma-shan. Mekong-Yangtze divide. Alt. 14,500 ft. Lat. 28° 20′ N. Plant of 6–12 ins. In fruit. Stony moist alpine pasture. G. Forrest. No. 13,231. August 1914.

This is a pretty oblique-flowered species. In habit it is like *P. Wardii*, Balf. f., but without alliance with that species, having white meal and no spurs to the bracts. It is really very near *P. gemmifera*, Batal., but the leaves have much longer petioles and a relatively shorter blade with deeper and larger teeth than in that species, and are always dusted with meal, as is the outside of the corolla. Then the flowers have a delicious fragrance, and the contrast between the orange-coloured eye and the pale lilac or violet petals is very pleasing.

The plant is very different from *P. sibirica*, Jacq., which has spurs to the bracts as in *P involucrata*, Wall. and in *P. Wardii*, Balf. f.

Plants raised from seed collected by Mr. Forrest have flowered with Messrs. Wallace at Colchester and also at Edinburgh in 1916. It is a free grower, after the fashion of *P. conspersa*, Balf. f. et Purdom and *P. Wardii*, Balf. f., and produces abundant lateral shoots which grow out as short stolons so that it quickly covers the soil. We have not yet at Edinburgh grown it in the open, but I expect it will be as hardy as *P. Wardii*, Balf. f. Like all mealy Primulas which depend upon the meal for their effect it may not be in the open so beautiful a plant as it is when grown under cover owing to the loss of meal under rain.

Primula Harroviana, Balf. f. et Cooper.[1]

A perennial small rosulate herb, the leaves and flowers coaetaneous. Leaves petiolate small at flowering period

[1] *Primula Harroviana*, Balf. f. et Cooper.—Rosulata rhizomate parvo foliis floribusque coaetaneis. Folia petiolata sub anthesi parva ad 5 cm. longa (sub fructu ad 11 cm. aucta); lamina elliptica vel oblongo-elliptica vel oblonga nunc ovata circ. 2·5 cm. longa ad 2 cm. lata apice

as much as 5 cm. long increasing to about 11 cm.; blade elliptic or oblong-elliptic or oblong sometimes ovate as much as 2·5 cm. long by 2 cm. broad at flowering time, rounded at apex, margin shortly lobulate with obtuse or somewhat truncate and denticulate lobules the teeth glandular and ending in a horny hydathode, green on both surfaces and concolorous, abruptly contracted into a conspicuous slightly winged equally long or slightly shorter petiole with a short open vagina; upper surface convex rugulose shining and punctulate (not viscid) with capitate stalked uncoloured potentially mealy glands, under surface reticulately alveolar clad with glands like upper surface but more densely. Scape as much as 8 cm. high (in fruit increasing to 12 cm.), 2 mm. in diameter, white-mealy, crowned by a many-flowered somewhat spicate capitulum; bracts small inconspicuous, lowermost about 5 mm. long lanceolate from the base, acuminate glabrous membranous, white with a green tip, hidden by the de-

rotundata margine breviter lobulata lobulis obtusis vel subtruncatis et denticulatis utrinque viridis concolor, supra convexa rugulosa glandulis capitatis stipitatis albidis farini-potentibus nitenti-punctulata haud viscida, subtus reticulatim alveolata glandulis ut supra densius vestita, in petiolum conspicuum leviter alatum aequilongum vel paullo breviorem subito contracta petioli vagina brevi aperta Scapus ad 8 cm (sub fructu 12 cm.) altus 2 mm. diam albo-farinosus capitulum multiflorum subspicatum gerens; bracteae parvae inconspicuae infimae 5 mm. longae floribus deflexis occultae a basi lanceolatae acuminatae supremae virides inter flores vix conspicuae. Calyx laete viridis deflexus obliquus tenuis tubum corollinum subaequans, tubo subventricoso postice convexo extus intusque plus minusve farinoso, lobis 5 tubum subaequantibus inaequalibus saepe inter se plus minusve conjunctis extus intusque glabris lobo postico maximo subquadrato lato vertice subtruncato et fimbriato glanduloso-ciliato decurvato (sed fimbriis apicalibus plerumque adscendentibus) antero-lateralibus minoribus saepe oblongis angustis ad apicem obtusis. Corollae eburneae infundibuliformis extus ex toto farinosae tubus cylindricus angustus tenuis circ 7–8 mm. longus supra stamina paullo ampliatus exannulatus, limbus late ampliatus profunde concavus farinosus 5-lobatus, lobi circ 3·5 mm. longi subtruncati bifidi segmentis approximatis et fimbriatis. Staminum filamenta brevia in flore brevistylo ad os corollinum inserta in flore longistylo infra medium tubi inserta. Ovarium globosum; stylus brevis vix 1 mm. longus, longus tubum corollinum aequans; stigma discoideum depressum flavido-album. Capsula globosa circ. 2·5 mm. diam. calyce aucto albo-farinoso inclusa in dimidio superiore crustacea infra membranacea valvis 5 ab apice ad medium dehiscens; semina complanata ovalia disciformia circ. 1·5 mm. longa pallide brunnea, testa papillata.

Species bene distincta in sectione Muscarioide, inter notas alias corolla eburnea, calyce laete viridi, corollae farinoso-glandulosae tubo longo angusto.

flexed flowers, upper ones green inconspicuous amongst the flowers; pedicels none; anthopodium hardly developed. Calyx bright green deflexed oblique thin equalling in length corolla-tube; tube 7 to 8 mm. long subventricose, posteriorly convex, both outside and inside white-mealy; lobes 5 equalling the tube glabrous outside and inside, unequal, posterior largest subquadrate often 2·5 mm. broad subtruncate at top and fimbriate glandular-ciliate decurved the fringe upturned, postero-lateral lobes like to but narrower than posterior, antero-lateral lobes smallest often oblong narrow and obtuse at apex, some lobes often confluent, posterior lobe including others in bud. Corolla ivory-white everywhere white-mealy outside, about 1·6 cm. long in short-styled flower, about 1·4 cm. long in long-styled; tube narrow about 1·25 mm. in diameter in short-styled flower, 2 mm. in long-styled, cylindric slender somewhat rugulose and shining inside, mealy above the stamens, in short-styled flower about 8 mm. long, in long-styled about 7 mm., slightly ampliate above the stamens, exannulate; limb widely ampliate deeply concave potentially mealy inside; lobes about 3·5 mm. long, subtruncate bifid the segments connivent and subfimbriate. Stamens with very short filaments slightly expanded at base, in short-styled flower inserted at mouth of corolla, in long-styled below middle of corolla-tube with anther-tips about 4 mm. from its mouth: anthers pale yellow with paler connective. Ovary globose with thin pale wall about 1·5 mm. in diameter; short style pale yellow scarcely 1 mm. long, long style reaching mouth of corolla-tube; stigma large yellowish-white discoid recurved depressed. Capsule pale brown, about 2·5 mm. in diameter crustaceous in upper half, without stylopod, membranous in lower half and there enclosed in the slightly enlarged mealy calyx, dehiscing to middle by 5 valves; placenta stipitate the stalk about 0·5 mm. long, ovuliferous area conoid 1 mm. in diameter wider than the stalk and reaching top of capsule. Seeds flattened oval disk-like about 1 5 mm. long, pale brown, testa papillate.

Bhutan. Cooper. No. 4975.

A charming white-flowered species of the Muscarioid section of Primula which flowered in the Royal Botanic

Garden, Edinburgh, in 1917. The plant was raised from seed derived from a dried specimen collected by Mr. Roland E. Cooper when exploring in Bhutan for Bees Ltd. Mr. Cooper's specimen bore no flowers. I have not yet seen enough of the species to enable me to say whether the capitate glands which occur all over the leaves and are undoubtedly potential farina-formers usually reach the stage of producing it. The scape and the flower are farinose.

In some ways *P. Harroviana*, like *P. nutans*, suggests the Soldanelloid section, approaching it in the relatively large ampliate limb of the corolla and the very narrow tube, in the farinose glands on the corolla, and in the fimbriate truncate corolla-lobes. But its inflorescence and calyx are essentially Muscarioid.

Only experience will tell us whether it is to be hardy or not. Named after Robert Lewis Harrow, Principal Gardener of the Royal Botanic Garden, Edinburgh.

Primula Hopeana, Balf. f. et Cooper.[1]

A tufted herb with the short hard rhizome and fibrous roots of *P. sikkimensis*, Hook., epilose. Leaves long narrow as much as 14 cm. long, 2 cm. broad; lamina chartaceous elongated oblong or oblanceolate, rounded at apex, margin erose dentate, teeth ending in a conspicuous

[1] *Primula Hopeana*, Balf. f. et Cooper.—Herba caespitosa *P. sikkimensi*, Hook. affinis. Folia angusta ad 14 cm. longa ad 2 cm. lata; lamina efarinosa elongata oblonga vel oblanceolata margine eroso-dentata deorsum in petiolum basi erubescentem anguste alatum lamina dimidio longiorem gradatim angustata, supra atro-viridis subtus pallidior utrinque glandulis brevibus capitatis farini-potentibus praedita. Scapus ad 30 cm. altus cum bracteis pedicellisque lacteo-farinosus umbellam 3–6-floram gerens; bracteae brunneo-purpureae lineares acuminatae circ. 8 mm. longae; pedicelli virides nutantes circ. 1·5 cm. longi (sub fructu aucti ad 9 cm.). Calyx angustus fusiformis 5-angulatus tubum corollinum subaequans dense farinosus fere ad basim 5-fissus lobis lanceolatis acutis intus apice farinosis. Corolla lacteo-alba extus glabra tubo cylindrico exannulato, limbo tubo paullo longiore infundibuliformi intus farinoso, lobis rotundatis circ. 5 mm. diam emarginatis. Stamina in flore longistylo tubi corollini basim versus inserta, filamentis conspicuis, antheris flavis angustis oblongis circ. 1·5 mm. longis apiculatis. Ovarium turbinatum; stylus longus exsertus; stigma flavidum depressum discoideum revolutum. Capsula basi calyce inclusa valvis 5 bidentatis ab apice ad medium dehiscens; placenta stipitata cylindrica; semina laevia magna complanata.

Species sectionis Sikkimensis foliorum capsulaeque magnitudine et floribus lacteo-albis distincta.

hydathode, tapered downwards into a long narrowly winged shining petiole half again as long as lamina without a vagina and often reddened at base, upper surface dark green, under surface paler, the midrib broad concave above, very prominent beneath, primary veins conspicuous below; upper surface sprinkled lower surface more thickly covered with nearly sessile capitate potentially mealy glands. Scape slender as much as 30 cm. high mealy with creamy-white meal as are the bracts and pedicels, bearing a solitary terminal umbel 3–6-flowered; bracts linear acuminate one-nerved about 8 mm. long 0·75 mm broad, brown purple; pedicels drooping fragile about 1·5 cm. long (elongating to 9 cm. in fruit) green, anthopode top-shaped at least 1 mm. long. Calyx narrow fusiform about 7 mm. long almost equalling corolla-tube 5-angled brown purple densely mealy outside, cut almost to base into 5 lanceolate acute keeled adpressed lobes without conspicuous hydathode sprinkled with meal inside at the top. Corolla cream-white glabrous outside; tube cylindric smooth within, exannulate, about 8 mm. long in long-styled flower tinted sometimes greenish or pink, expanding into a 5-lobed funnel-shaped limb about 1 cm. long densely mealy inside; lobes rounded with smooth edge emarginate about 5 mm. long and broad. Stamens in long-styled flower inserted about 1·75 mm. from base of corolla-tube, filaments greenish expanded at base slightly shorter than narrow oblong yellow anther which is about 1·5 mm. long with greenish connective and short apiculus. Ovary somewhat top-shaped; long style slightly exserted pale green, stigma large tinted yellow discoid depressed slightly revolute. Capsule cylindric about 9 mm. long about 3 mm. in diameter, in lower two-thirds enclosed by calyx, crustaceous where exposed membranous within calyx, chestnut-brown glistening, dehiscing from the apex by 5 valves each usually splitting into 2 teeth; placenta cylindric with short stipe 1·25 mm. long, placentiferous area about 7·5 mm. long; seeds large flattened about 2 mm. long by 1·5 mm. in diameter often curved round the placenta, smooth, obscurely squamous on surface, amber-coloured.

Bhutan. Ridge S.E. of Angduphorang. Alt. 13,500 ft.

Among boulders in sandy peat turf by streams. R. E. Cooper. No. 4807. 16th September 1915.

A beautiful new species of the Sikkimensis series—fragrant as members of the series are. Its creamy-white flowers, short capsules, and shorter and narrower leaves distinguish it from others of the series. From seeds collected by Mr. Cooper for Mr. Bulley—some of which were generously presented by Mr. Bulley to the Royal Botanic Garden, Edinburgh—plants have been raised and flowered by Mr. Bulley and also at Edinburgh in 1917. It is a free-growing plant, not so large or so floriferous as *P. sikkimensis*, and I see no reason to doubt that it will prove as hardy as is that species.

The plant is named after Joseph Hope, gardener to Mr. Bulley at Ness, Neston, Cheshire, to whose skill is due the raising of the plants from seeds collected by Mr. Cooper in Bhutan.

Primula Maclareni, Balf. f.[1]

A multicipital herb the leaves deciduous annually from the somewhat elongated underground rhizome. Rhizome producing ovoid perennating chamber-buds covered by a few red-brown membranous cucullate scales. Leaves erect long-petiolate as much as 37 cm. long (Maclaren), lamina of reniform or nearly orbicular outline about 8 cm. in transverse diameter with 7–9 divergent primary veins,

[1] *Primula Maclareni*, Balf. f.—Herba multiceps gemmis globosis magnis perennans rhizomate elongato foliis mox deciduis. Folia elata erecta longe petiolata ad 37 cm. longa; lamina ambitu reniformis vel suborbicularis multi-lobata lobis triangularibus acutis dentatis glanduloso-pilosa margine glanduloso-ciliata basi cordata. Scapus ad 7 dm. longus, cum bracteis pedicellisque calyceque glanduloso-pubescens vel puberulus umbellam terminalem et verticillos 2–3 ad 8-floros gerens; bracteae lineari-subulatae virides circ. 4 mm. longae pedicellis breviores; pedicelli breves circ. 6 mm. longi virides nutantes. Calyx viridis campanulatus circ. 8 mm. longus fere ad basim 5-lobatus lobis lanceolatis uninerviis sinubus membranaceis, hydathodeo conspicuo terminatis. Corolla atro-kermesina viridi- vel flavido-oculata, tubo in flore longistylo circ. 1 cm. longo in brevistylo 1·2 cm., extus glanduloso-puberulo, annulato, limbi plani disco circ. 2 mm. lato minute glanduloso-puberulo, lobis 5 obcordatis vel cuneatis bifidis. Stamina in flore brevistylo ad os tubi corollini inserta in flore longistylo basim versus inserta, filamentis conspicuis, antheris luteis connectivo lacteo-albo. Ovarium turbinatum; stylus brevis calyce brevior, longus paullo exsertus; stigma discoideum viride.
Species in sectionem Geranioides ponenda et magnitudine atque inflorescentia candelabroidea distinguenda.

shallowly 7–9 lobed, lobes triangular acute more or less dentate, lobes and teeth ending in a prominent hydathode often 1 mm. long, margin ciliate with glandular hairs, base cordate with an open or closed sinus, upper surface bright green, lower paler both glandular-hairy; petiole about 9 cm. long green glandular hairy. Scape about 5–7 dm. long (Maclaren) far exceeding the leaves, green glandular-pubescent as are the bracts and pedicels and outside of calyx, bearing 2–3 whorls and a terminal umbel of 6–8 flowers each, bracts linear-subulate about 4 mm. long, green, pedicels short about 6 mm. long drooping, green; anthopode narrow. Calyx campanulate green about 8 mm. long glabrous inside, cut to near the base into 5 lanceolate patent divaricate one-nerved lobes, nerve inconspicuous and ending in a large pale yellow green hydathode, sinuses membranous. Corolla crimson-lake (in bud deep plum-purple) with yellow-green or yellow-tinted eye, tube tinted red outside, cylindric below the stamens, ampliate above them, glandular-puberulous outside, more or less transversely rugose, in long-styled flower about 1 cm. long in short-styled about 1·2 cm, annulate, annulus of ten lobes antipetalous in pairs, limb flat, disk about 2 mm. broad shortly gland-puberulous olive-green or tinted yellow and bounded by a narrow deep-magenta ring, lobes 5 obcordate or cuneate about 8 mm. long and broad, deeply bifid, segments divaricate often lobed and with an apiculus in the sinus Stamens in long-styled flower inserted about 4 mm. from base of corolla-tube, in short-styled near the top the anthers reaching the annulus, filaments stout conspicuous nearly as long as the anther, anther ovate apiculate yellow with cream-white connective about 1·25 mm. long. Ovary smooth turbinate; long style slightly exserted, short style shorter than calyx, stigma discoid green

Central Korea. Province of Whanghaido. Flowering June 1915. Growing in rank grass at bottom of a narrow valley at 4000 ft. Uncommon. Only seen in one group. Mr. Malcolm Maclaren—after whom the plant is named.

A tall-growing species of the Geranioid section, differing from all other described members of the section by its tiered candelabra inflorescence reaching over 7 decimeters

in height, giving it the appearance, as Mr. Maclaren its discoverer remarks, of *P. japonica*. *Rh. septemloba*, Franch. sometimes but seldom shows one whorl below the terminal umbel. There is, however, a Yunnan plant of the section rivalling *P. Maclareni* in the size of the scape and number of tiers of flowers. It was found in 1913 by Mr Forrest on the Chungtien Plateau at 10,000 ft., and he speaks of it as a plant of 2½ ft. high. The dried specimens in Mr. Forrest's collection are in fruit only, and whilst I have no doubt about it being a new species as yet undescribed, I have not felt warranted up till now in describing it in the absence of flowers.

Seeds of the Korean plant were presented to the Royal Botanic Garden, Edinburgh, by Mr. P. D. Williams, of Lanarth, Cornwall, and seedlings raised from them flowered in 1917. The plant has not yet been grown in the open and has not attained its maximum size. The longest scapes on our plants were about 18 ins., and they produced three whorls of flowers below the terminal umbel.

The plant loses its foliage after flowering, like *P. jesoana*, Miq. of the same section, and perennates like it by the formation of numerous ovoid or globose buds on the rhizomes. These buds look like bulbils, but they have no fleshy scales and are really chamber-buds, that is to say, each is composed of a number of membranous scale-leaves, the outer brown closely enrolling the inner green ones and forming a chamber in which are found the already formed young leaves and the incipient flower-shoot of the next season standing on a broad flattened axis and not overlapping nor filling up the chamber. The scale-leaves are viscid, the secretion acting as in other cases as a protection to the young soft parts within.

Primula rupestris, Balf. f. et Farrer.[1]

A sticky perennial herb coated everywhere with long and short glandular hairs. Leaves as much as 13 cm. long

[1] *Primula rupestris*, Balf. f. et Farrer.—Herba multiceps. Folia longe petiolata ad 13 cm. longa viscida glanduloso-pilosa pilis brevibus et longis intermixtis; lamina elliptico-ovata ad 4 cm. longa et lata fere rotundata margine plerumque 7-lobata lobis inaequaliter lobulatis lobulis obtusis vel rotundatis vel subtruncatis ad apicem rubro-punctatis basi cordatis sinu clauso, supra convexa atro-viridis opaca,

with long petioles; lamina elliptic-ovate or almost rounded as much as 4 cm. long and broad, rounded at apex, usually 7-lobed the lobes unequally lobulate each lobule obtuse rounded or somewhat truncate its mid-vein ending in a red point, base cordate with usually a closed sinus, upper surface opaque dark green convex, under surface more or less red prominently venulose; petiole much longer than lamina about 9 cm. long red, terete but for a slightly grooved upper surface, swollen at very base into a vaginal cushion. Scape as much as 15 cm. high bearing a terminal umbel and one or two lower whorls of flowers usually about 5–6 in a whorl or umbel; bracts linear acute about 1 cm. long and 1 mm. broad, green with a red vagina; pedicels unequal 2–4 cm. long spreading red, attached to centre of slightly hollowed broad base of calyx. Calyx inversely funnel-shaped about 5–6 mm. long (enlarging in fruit) about half the length of the corolla-tube which is glandular-puberulous outside, inflated at base and there about 5–6 mm. in diameter, narrowed upwards and divided to beyond middle into 5 adpressed elongated triangular obtuse or acute lobes often paler than the green tube. Corolla white, lilac, or rose with a yellow-green eye glandular-puberulous through-

subtus concava plus minusve rubra prominenter venosa; petiolus lamina multo longior ad 9 cm. longus ruber crassus teres sed supra paullo sulcatus basi in vaginam pulvinatam incrassatam expansus. Scapus ad 15 cm. altus umbellam terminalem et verticillos 1–2 ad 6-floros gerens; bracteae lineares acutae circ. 1 cm. longae 1 mm. latae virides basi in vaginam subamplexicaulem pulvinatam expansae; pedicelli in quaque umbella vel verticillo variabiles nunc 4 cm. longi nunc 2 cm. ad centrum fundi calycini intrusum late affixi rubri patentes. Calyx obinfundibuliformis extus intusque glandulosus glandulis stipitatis, basi inflatus ibique circ. 5–6 mm. latus sursum augustatus sub anthesi circ. 5–6 mm. longus (demum auctus) tubo corollino dimidio brevior ultra medium 5-lobatus lobis elongato-triangularibus obtusis ad corollam adpressis tubo viridi pallidioribus. Corollae extus conspersim glandulosae tubus cylindricus supra stamina ampliatus in flore longistylo circ. 1 cm. in flore brevistylo circ. 1·4 cm. longus albidus et flavido-tinctus extus glanduloso-puberulus intus glaber exannulatus fauce circularis, limbi plani patentis discus flavido-viridi-oculatus substrumosus 1 5 mm. latus supra glanduloso-puberulus, lobi 5 obcordati albi vel violacei vel rosei profunde emarginati. Stamina in flore longistylo basim versus in flore brevistylo supra medium tubi corollini antherarum apicibus ab ore 3·5 mm. remotis inserta antheris angustis fere sessilibus circ. 2 mm. longis. Ovarium fere globosum viride; stylus albidus, longus inclusus calycem superans, brevis vix calycem aequans ovario duplo longior; stigma pallide viride capitatum.

Species *P. sinensi*, Lindl. affinis calyce sursum abrupte contracto lobis sepalinis adpressis, corollae limbo minore inter notas alias recognoscenda.

out outside, tube cylindric expanded above stamens, in long-styled flower about 1 cm. long, in short-styled about 1·4 cm. long, about twice the length of calyx, white tinted yellow at top, glabrous inside, exannulate with a circular mouth; disk of the flat spreading limb about 1·5 mm. broad yellow-green glandular-puberulous somewhat strumous at base; lobes 5 obcordate 1 cm. long and broad or more, deeply emarginate minutely papillose above. Stamens in long-styled flower inserted near base of corolla-tube about equalling calyx in short-styled above middle of corolla-tube with anther-apices about 3·5 mm. from its mouth, anthers almost sessile narrow about 2 mm. long. Ovary green nearly globose, style white, long style included in corolla-tube a little longer than calyx, short style scarcely as long as calyx, twice length of ovary; stigma pale green capitate.

Szechwan. "*Primula rupestris* occurs on hard dry reddish limestone cliffs in the Da' Ba San (Ta Pa Shan), seen first between Ming Chiang Chow and Tai-an-i, down over the Shensi-Szechwan border, and last seen on a limestone bluff above the Kia Ling Kiang where it debouches into the Red Basin of Szechwan. The journey between Lo-yang and Kwang-Yuen goes each day over a low little wooded range running up to some 8000 ft. The Primula haunts cliff-faces in the gorges, exactly as *P. Allionii* grows in the dry hard cliff-faces of the Roja. Only withered relics were to be seen when I passed through in early November 1915; in fact it was only with much difficulty and after long search that I succeeded in finding a few seeds still lingering. In such conditions it is hardly to be wondered at if I failed to differentiate it from *P. sinensis*, remote though such an extension of distribution would have been. I have no doubt that *P. rupestris* pervades all those small low ranges of the Da Ba San on its limestone outcrops, on the gorge-cliffs, etc., at an elevation of some 6000–7000 ft. Its habits and habitat suggest a great dislike for winter damp, but from its geographical station I hoped it might prove as much hardier than *P. sinensis* as has since been proved to be the case."—R. Farrer.

From seed collected by Mr. Farrer, *P. rupestris* is now in cultivation and flowered in 1916 in the Royal Botanic

Garden, Edinburgh. It is a near ally of the well-known *P. sinensis*, Lindl. of Western Hupeh and Eastern Yunnan, the only species hitherto described of the Auganthus series of Primula. Hardier than its ally, it may prove a valuable addition to the plants of the outdoor garden, especially if it varies as much as *P. sinensis* under cultivation. It differs from the wild plants of *P. sinensis* in its larger leaves with longer and stouter petioles, its longer and stouter pedicels, the calyx abruptly tapering from the swollen base into the elongated triangular adpressed lobes more than half the length of the calyx, the smaller corolla limb. As in *P. sinensis* the corolla is glandular on the outside. I mention this because Pax says the corolla in *P. sinensis* is eglandular.

At the Primula Conference in 1913 I referred to the geographical distribution and the variability of the Chinese species *P. sinensis* and *P. obconica*, Hance, pointing out that whilst the latter is widely spread in Western China and shows many form-modifications in relation to habitat in cultivation, it has not varied or developed to the extent exhibited by *P. sinensis*, which is only known from the one area about Ichang Here we have now in this Szechwan plant a form-modification of the type of *P sinensis*, and it may be taken as indicating that there are probably others to be discovered in the wide region that intervenes between W. Hupeh and Kansu. There is another form in cultivation, found by Wilson in W. Szechwan (I believe), but no description of it has yet appeared—a fate that has attended so far many interesting new forms of Primula collected by Wilson, dried specimens of which have been distributed by the Arnold Arboretum.

Primula scopulorum, Balf. f. et Farrer.[1]

A pretty plant coated with yellow meal forming a rosette of nearly prostrate leaves beneath which are the dry

[1] *Primula scopulorum*, Balf. f. et Farrer.—Species parva rosulata foliis prostratis luteo-farinosis. Folia oblonga vel oblongo-ovalia vel oblongo-elliptica irregulariter dentata fere sessilia supra sparsim subtus dense luteo-farinosa. Scapus ad 3 cm. longus cum bracteis pedicellisque luteo-farinosus umbellam ad 13-floram gerens, floribus deinceps evolutis; bracteae ovato-lanceolatae ad 7 mm. longae; pedicelli ad 2 cm. longi. Calyx anguste campanulatus ad 7 mm. longus 5-costatus ad medium 5-lobatus extus intusque luteo-farinosus lobis oblongis vel

withered leaves of previous years. The roots from the small rhizome delicate in relation to the mossy soil of its native habitat. Leaves as much as 4 cm. long and 2 cm. broad oblong or oblong-oval or oblong-elliptic rounded at apex irregularly toothed on margin the teeth ending in conspicuous hydathodes, base more or less narrowed to a hardly distinct petiole, primary veins feathered and ascending, upper surface sparingly lower surface densely coated with yellow meal. Scape short as much as 3 cm. long stoutish and like the bracts and pedicels yellow-mealy, bearing an umbel of as many as 13 flowers which open one or two at a time in succession; bracts ovate oblong-lanceolate keeled and cucullate, as much as 7 mm. long, pedicels stiff stoutish spreading, as much as 2 cm. long; anthopode top-shaped often 1 mm. long. Calyx narrowly campanulate as much as 7 mm. long 5-ribbed, the sinuses not thinner, with yellow meal outside and inside, split to about the middle into 5 oblong or oblong-ovate acute lobes their midrib and lateral ascending veins conspicuous without evident terminal hydathode. Corolla red-violet with yellow eye, coated outside where exposed with yellow meal, somewhat membranous; tube cylindric tinted red, in short-styled flower about 1·4 cm. long, in long-styled about 1·2 cm., transversely rugose the uppermost ridges at the throat swollen into a sort of annulus, disk of the limb yellow about 1·5 mm. broad most minutely puberulous, lobes as much as 1 cm. long and broad imbricate obovate or somewhat obcordate deeply bifid the segments divaricate. Stamens with very short filaments, the anthers about 2·5 mm. long, ochre-coloured with purple connective, in short-styled flower inserted near top of corolla-tube the anther-tip about 1·5 mm. from the mouth, in long-styled flower near base of corolla about equalling the calyx.

oblongo-ovatis acutis. Corolla rubro-violacea luteo-oculata extus luteo-farinosa tubo in flore brevistylo circ. 1·4 cm. longo, in longistylo circ. 1·2 cm., ore strumoso pseudo-annulato, lobis obovatis vel subobcordatis circ. 1 cm. longis bifidis. Stamina in flore brevistylo prope os corollae inserta in longistylo prope basim. Stylus longus inclusus stigmate ab ore corollae circ. 2·5 mm. remoto, brevis calyce paullo brevior; stigma discoideo-capitatum.

Species *P. membranifoliae*, Franch, affinis foliis fere sessilibus, pedicellis calyceque multo brevioribus, corolla efarinosa inter notas alias facile distinguenda.

Ovary with flat summit somewhat top-shaped; style and stigma pale green, long style included, the stigma about 2·5 mm. from corolla mouth, short style slightly shorter than calyx; stigma discoid-capitate.

Kansu. "The specimens show the plant at its best, and are from cool shady moss ledges (10th May) on the limestone at about 6000–8000 ft. in the Satanee Alps. In those of Siku it ascends actually to the summit ridges at 12,000–13,000 ft. (22nd June), but here (I think the northerly limit of its range) it is in all situations and heights much squinnier and poorer in all ways than these fine but typical specimens of the Satanee Alps. (Flowers from April–May, low down, to the end of June on the tops.)" F. 39. P. No. 2. Farrer and Purdom. Coll. 1915.

This species found by Messrs. Farrer and Purdom is now in cultivation from seed collected by them, and it flowered in the Royal Botanic Garden, Edinburgh, in 1916 in a cold pit. It has not been grown outside yet, though it is probably hardy, but covered as it is with yellow meal, easily washed off by rain, it will likely lose much of its effectiveness when grown in the open.

One of the Yunnanensis series of Primula, its nearest ally is the Yunnan *P. membranifolia*, Franch. That species is readily distinguished by the large cushion which it forms, its paler leaves spathulate in form, its thinner scape much shorter pedicels and calyx and by the colour of the corolla and absence of meal on the outside of it.

The flat prostrate rosette of leaves is a conspicuous character of *P. scopulorum*, as is also the long period of flowering. This results from the production of many flowers in the umbel and their unfolding one after the other. One sees the same prolonged flowering in other members of the Yunnanensis series.

Either *P. scopulorum* is a variable plant in Kansu or two species very like one another and growing together have been gathered and treated as one. Messrs. Purdom and Farrer's dried specimens show two forms, and amongst our cultivated plants two forms have appeared. I am not yet prepared to deal with this problem.

(*Issued separately* 29*th December* 1917.)

Some Late-Flowering Gentians.

By Professor Bayley Balfour, F.R.S.

(Read 14th February 1918.)

There is a small series of Asiatic Gentians belonging to the Section named Frigida by Kusnezow which are the glory of the autumn garden, but which, as introductions of more or less recent years, are not yet known as they ought to be and will be. There is some confusion in their nomenclature, and I shall take the opportunity to clear this up when writing now, as I propose to do, upon the characters and distinctions of the species.

The species to which I refer are four:—

G. Farreri, Balf. f.	Kansu.	Discovered, Farrer and Purdom, 1914. Introd. Farrer, 1914. First flowered, Edinburgh, 1916.
G. Lawrencei, Burkill	Siberia (Baicalia)	Discovered, Bocherel. Introd. Leichtlin, 1905. First flowered, Sir Trevor Lawrence, 1905.
G. sino-ornata, Balf. f.	Yunnan.	Discovered, Forrest, 1904. Introd. Bulley, 1911. First flowered, Ness and Edinburgh, 1912.
G. Veitchiorum, Hemsley.	Szechwan	Discovered, Wilson. Introd. Veitch, 1905. First flowered, Veitch, 1905

They are prostrate forms spreading by stolons—reaching in *G. sino-ornata* some 18–25 cm. in length—from a central rosette. Each stolon prostrate at first ascends as its vegetative growth ceases and ends in a single flower. These stolons may root, and at the point of rooting start a new rosette whence new stolons are emitted. Thus the plant may cover a considerable area in the garden. *G. Veitchiorum* seems to be the least effusive in its extension. The whole of them have paired leaves connate at the base. By this character they are at once separated from another series of the Section Frigida, that of *G. ternifolia*, Franch., *G. tetraphylla*, Franch., *G. hexaphylla*, Franch., and *G. Arethusa*, Burkill, in which there are always more than two leaves in the nodal whorl. In the Ternifolia series occur flowers no less beautiful and late flowering than those of the series of which I am writing,

but only one species—*G. hexaphylla*, Franch.—is in cultivation so far as I know. Introduced by Farrer, it flowered at Edinburgh in August 1916, in plants raised from seed presented by the late Robert Woodward, Esq., jun., of Arley Castle, Bewdley.

In the paired-leaved series of which I write, the leaves of the pair have each the potentiality to produce an axillary shoot, but as so commonly happens in such cases the bud of one of the leaves is prepotent, and the prepotent buds in successive pairs follow a ¼ spiral course round the axis which produces them If a prepotent bud develops a shoot, its sister bud in the opposite leaf-axil is suppressed, but if from any cause the prepotent bud be arrested or destroyed, then the energies of the sister bud are called upon and it may elongate as a shoot. Thus each stolon has capacity to branch—a double chance from each node—and these branches, each of them, has, like the mother stolon, the power to root at the nodes and to end in one flower. The vegetative and reproductive capabilities of the plant are therefore great. *G. Farreri*, *G. Lawrencei*, and *G. sino-ornata* exhibit this stolon-branching to the greatest extent —*G. Veitchiorum* in my experience the least. And this seems to be constitutional For the former are the most satisfactory of plants, and the flexibility of their parts lends them to the most ordinary of handling. On the other hand *G. Veitchiorum* seems to be, at Edinburgh, a less adaptable plant—stiffer, less ready to respond.

In the solitary terminal flowers the calyx has an entire tube with long distinct lobes. By entire I should perhaps explain that the tube of the calyx is not split down one side as it is, for instance, in *G. decumbens*—to name a well-known garden plant. The distinction is an important one for differentiation of species of Gentian. The corolla, large and showy, some 5–6 cm. long, obconoid and funnel-shaped, sometimes slightly bulged above the calyx, is of various shades of blue, and has broad paler striped or suffused petaline bands on the outside. The folds, though toothed, are never fringed. The ovary has a long stalk, and the style is also long, with the branches recircinate at the tip.

These Gentians grow at Edinburgh in any good moist garden soil, either in shade or in full sun exposure—flower-

ing perhaps better under exposure. Every shoot will strike —those of the narrow-leaved species most freely.

Gentiana Farreri, Balf. f.[1]

Perennial herb with thick roots and very many branching stolons freely rooting and spreading from a primary central rosette, the stolons forming many new rosettes from the leaf-axils at the rooting nodes. Stolons as much as 18 cm. long prostrate at the base, then ascending, having terete internodes about 1 cm. long and 2 mm. in diameter, generally green and without surface papillae, sometimes reddening. Leaves epetiolate thick opposite, each pair connate and forming a vaginal somewhat loose sheath as much as 5 mm. long; lamina of upper region of stolon over 2 cm. long 2 mm. broad, in the primary rosette as much as 6 cm. long 5 mm. broad (on rosettes of the stolons somewhat smaller), linear not contracted at the base, towards top narrowed into an acute or acuminate apex, margin obscurely scaberulous, on both sides whitely-papillose, concave above dark-green glossy, paler beneath, midrib slightly raised in the sinus of the longitudinal groove. Flower solitary terminal, pedicel stout as much as 1 cm. long 3 mm. in diameter often reddened. Calyx as much as 5 cm. long, slightly shorter than corolla 5-lobed; tube somewhat funnel-shaped not split, as much as 2 cm. long 5 mm. in diameter, somewhat membranous green outside sometimes reddish at the base, intracalycine membrane green truncate transversely rugose; lobes somewhat thick

[1] *Gentiana Farreri*, Balf. f.—Herba perennis stolonifera Stolones radicantes ramosi ad 18 cm. longi a rosula centrali patentes. Folia stolonum epetiolata opposita vaginato-connata linearia acuta vel acuminata recurva 2 cm. longa vel ultra, 2 mm. lata, vel majora. Flos solitarius terminalis; pedicellus circ. 1 cm. longus. Calycis tubus infundibularis haud dimidiatus circ. 2 cm. longus; lobi duplo longiores lineares recurvi basi haud angustati. Corolla obconoideo-tubulosa ad 6 cm. longa extus vittata vittis flavido-albidis lineato-tinctis intus citrino-maculata, fauce alba; lobis ovatis circ. 8 mm. longis sub-apiculatis methylo-coeruleis nitentibus, plicis 3 mm. longis 7 mm. latis erosis. Filamenta staminum in parte libera circ. 9 mm. longa anguste alata; antherae sagittatae. Ovarium 1·5 cm. longum; stipes circ. 2·2 cm. longus; stylus ad 7 mm. longus ramis stigmatiferis 4 mm. longis recurvis.

Species Sectionis Frigidae *G. Lawrencei*, Burkill affinis sed robustior et calycis lobis tubo triente longioribus, corollae colore facile recognoscenda.

Kansu, in alpibus Jo-Ni.

very long, 3 cm. or more long, barely 1·5 mm. broad, like the uppermost leaves linear acuminate, subequal distant recurved not contracted at the convex base. Corolla obconoid-tubular as much as 6 cm. long spreading to over 3 cm.; tube within the calyx not 5 mm. in diameter, greenish-white, expanding upwards beyond calyx and showing on outside five broad yellowish-white bands on the median of the petals (antipetaline), each band having a central narrow greenish-blue line and a similarly coloured longitudinal ridge on each margin, inside sprinkled with small green and citron-yellow antipetaline spots, the interpetaline areas more or less pale-white and suffused with blue, throat white; lobes 5 broadly ovate or trigonous acute somewhat apiculate, about 8 mm. long and broad, recurving, outside traversed by the antipetaline bands, on the inside shining satiny of a methyl-blue colour; plicae semi-lunate methyl-blue coloured above, underneath paler more opaque, about 3 mm. long 7 mm. broad, erose, the middle tooth longer. Filaments of the stamens free through about 9 mm. and there narrowly winged about 1 mm. broad, intensely purple on the outside, white on the inside; anthers sagittate about 3 mm. long. Ovary 1·5 cm. long; stipe about 2·2 cm. long; style as much as 7 mm. long its stigmatiferous branches about 4 mm. long, recurving.

Kansu. Jo-Ni alps. Farrer and Purdom, 1914.[1]

Specimens of this species were not brought by Farrer, and my description is based upon living plants which flowered in the Royal Botanic Garden in August 1916. They were raised from seeds presented by the late Robert Woodward, Esq., jun., of Arley Castle, Bewdley—a portion of his share in the produce of Mr. Farrer's expedition.

G. Farreri is a superb species, perhaps the finest of the series to which it belongs. The wonderful sheen of the blue of its petals and folds above the white throat is its outstanding flower-feature, and the recurving of the corolla shows off the colour to advantage. It seems to be less affected by weather conditions than is the case with other Gentians. Sunshine is not necessary for the flower-expansion, although in sunshine only is the full glory of its colour displayed. On dull cloudy days as in bright sunshine the plant opens flowers freely. And the flower

[1] See Farrer, On the Eaves of the World, ii (1917), 214, 216.

does not always close on the approach of twilight. There are better and poorer flowered individuals noticeable in the cultivated plants—some opening the trumpet widely, others keeping the corolla-lobes more erect. It begins to flower at Edinburgh in late August, and continues until winter frosts destroy its aerial shoots. Rooting as it does at every node propagation of it is easy.

When in flower there is no other species with which *G. Farreri* can be confused. The Siberian *G. Lawrencei*, Burkill, is its nearest ally, but that wants the fine flower-colour, its flowers do not open in the wide trumpet-form of *G. Farreri*, and its leaves and stem are altogether more delicate. From *G. sino-ornata*, Balf. f., and *G. Veitchiorum*, Hemsl., others of its allies, it is easily diagnosed. They have flowers of a royal blue and purple-blue colour, and the latter has shorter blunt leaves.

Gentiana Lawrencei, Burkill, in Gard. Chron., 3, xxxviii (1905), 307, fig. 119.[1]

G. ornata, Bot. Mag. (1907), t. 8140.

Perennial spreading herb with thick roots and forming a compact rosette from which emerge many long leafy stolons rooting at the nodes. Stolons as much as 15 cm long thin about 1 mm. in diameter with cylindric usually

[1] Burkill's description runs:—

Gentiana Lawrencei, Burkill.—*G. ornatae*, Wallich, valde affinis foliis autem elongatis distinguitur. Planta perennis diffuse caespitosa. Caules plures, subdecumbentes, nec angulati, ad 10 cm. longi. Folia nitentia, arcuata, per paria vaginato-connata, infima 5 mm. longa, suprema 20 mm. longa, 2 mm. lata, acutissima; vagina 3 mm. longa. Calycis tubus 12 mm. longus, margine membranaceo integer; dentes quinque foliis supremis persimiles, parum inaequales, 14-18 mm. longi. Corollae tubus 40 mm. longus, infra albidus et atro-coeruleo-striatus, faucibus coerulescens; lobi deltoideo-ovati, acuti, laete coerulei, 5 mm. longi, 4 mm. lati; plicarum lobi late deltoidei, 2 mm. longi, 4 mm lati, margine subintegri. Filamenta 30-32 mm. longa, ad corollam infra medium annexa, violacea. Ovarium 12 mm. longum; stipes basi mellifluus fere 20 mm. longus; stylus 1 mm. longus; stigmata 8 mm. longa.

A handsome Gentian, brought into cultivation by Herr Max Leichtlin of Baden-Baden. The specimens from which the description is drawn flowered in the garden of Sir Trevor Lawrence at Burford, Dorking, to whom we are indebted for the specimens here illustrated. The original seeds were collected by M. Jules Bocherel on a journey into Mongolia from Lake Baikal. *Gentiana ornata*, its nearest ally, is a native of the Eastern Himalaya and South-West China. *Gentiana ternifolia*, Franchet, is another ally which comes from Yunnan; *Gentiana tetraphylla*, Kusnezow, and *G. hexaphylla* Maximowicz, are allies growing in

reddening long internodes as much as 2 cm. long in upper part, prostrate at base branching above, each branch ascending and ending in a single flower or some branches arrested and forming nodal rosettes whence new stolons arise. Leaves of the upper region of stolons linear-filiform running out to a long point, as much as 2·5 cm. long hardly 1·5 mm. broad hardly recurving not constricted at base, epetiolate, passing at once into a vagina connate with that of opposite leaf into a sheath about 3 mm. long. Flower solitary terminal; pedicel as much as 1·2 cm. long barely 2 mm. in diameter red. Calyx about 3·5 cm. long; tube funnel-shaped not split, about 1·3 cm. long 3·5 mm broad angular, shining outside very red at the base, above somewhat blistered, dark-green, inside pale-green slightly rugulose, intracalycine membrane truncate; lobes subequal distant linear-filiform to a long point, over 2 cm. long about 1·5 mm. broad, not contracted at base, somewhat involute dark-green erect spreading not markedly recurved. Corolla obconoid-tubular about 5·5 cm. long spreading to about 2 cm., tube within the calyx pale-green about 3 mm. in diameter, above that with 5 antipetaline bands greenish-white not spotted but with a central narrow faint purple line and two lateral broader purple boundary ridges, interpetaline areas white tinted pale sky-blue, inside unspotted white rugulose on antipetaline areas, throat striped pale blue and white, lobes 5 broadly ovate or trigonous obtuse and slightly apiculate pale sky-blue about 6 cm. long and broad half patent; folds paler than lobes, about 3 mm. long and 7 mm. wide, broadly triangular erose with a longer often aristate tooth about the middle. Staminal filaments free through 1·2 cm. tinted pale blue, inserted about 2·1 cm. above base of corolla, narrowly winged; anthers sagittate 4 mm. long. Ovary about 1·4 cm. long; stipe 2·5 cm. long; style 6 mm. long its stigmatiferous branches about 1·5 mm.

Siberia. About Lake Baikal. Bocherel.

This species was described and figured by Burkill from

Szechuan. The whole group consists of plants with showy flowers, but *G. ornata* is the only one which has been in cultivation prior to the introduction of *G. Lawrencei*.

The flowers of *G. Lawrencei* are $1\frac{3}{4}$ inch long, upright, and blue above, the lower part of the tube being pale, with dark blue lines. They stand solitary on the ends of ascending narrow-leaved branches.

plants which flowered with Sir Trevor Lawrence in 1905. The plant came from Max Leichtlin, who raised it from seed collected by M. Jules Bocherel about Lake Baikal, as Burkill informs us. A plant from the same source was received at the same date at, and its progeny still flourishes in, the Royal Botanic Garden, Edinburgh. The history of the plant figured in the Botanical Magazine (1907),[1] t. 8140, under the name *G. ornata*, Wall., is that of Sir Trevor Lawrence's and of the Edinburgh plant, and the figure is that of *G. Lawrencei*. It is not *G. ornata*, Wall. I do not understand the reference under the figure to Walton's specimens. These were described by Burkill under the name of *G. Waltoni*[2]—a species with a dimidiate-spathaceous calyx altogether different from the type of *G. ornata*.

G. Lawrencei is a pretty species, most like *G. Farreri* of those I speak of here. It is, however, a more slender plant, with thinner stolons and much narrower leaves—they are almost thread-like at times—and they do not recurve in the manner of those of *G. Farreri*. It is very sensitive to atmospheric states, and is therefore at a disadvantage with *G. Farreri*. The flowers are only open in brightest sunshine and in a warm dry atmosphere. The flower has always a purple-red thin stalk, about a centimeter or more in length and little over a millimeter in diameter, and it gives the impression of being scarcely strong enough to support erect the large flower. The calyx-tube is shorter than in *G. Farreri*, as are also the thin almost filiform lobes which remain erect and do not recurve. The expanded mouth of the corolla-tube is only about 2 centimeters across —in *G. Farreri* it is 3 cm.—and the lobes and folds do not reflex to the extent they do in *G. Farreri*, so that the mouth has not the broad trumpet-form of that species. The throat is not pure white as there but lined with blue, and the blunt lobes with the folds, which are somewhat erose, are of a paler sky-blue tint. If it would only open its flowers, which are profusely produced,—as freely as in *G. Farreri* —it would more closely rival that species for favour. *G. Lawrencei* is like *G. Farreri* a long flowerer—opening

[1] See also Gard. Chron., 3, xl (1906), 182.
[2] Burkill in Journ. Proc. Asiat. Soc. Beng., n.s. ii (1906), 310.

at Edinburgh in late July and continuing during the autumn—and it is as easily propagated.

Gentiana sino-ornata, Balf. f.[1]

G. ornata, Forrest (not of Wallich), in Notes Roy. Bot. Gard. Edin., iv (1907), 71.

G. ornata, Hort. (not of Wallich).

Perennial herb with thick roots producing many spreading rooting stolons from a primary central rosette, and forming new axillary rosettes at the rooting nodes. Stolons 18 cm. or more long, prostrate at the base ascending towards the apex composed of short terete more or less papillate reddish internodes. Leaves epetiolate thick somewhat fleshy opposite connate each pair forming a short vaginal sheath about 2·5 mm. long; lamina in the primary rosette linear-lanceolate from the base as much as 1·5 cm. long 3 mm. or more broad not narrowed at the base, margin in the young leaves whitely cartilaginous subsequently scaberulous and at the base minutely ciliolate, whitely papillate on both surfaces, concave dark-green glossy above, paler beneath, midrib slightly elevated at bottom of longitudinal groove; lamina of lower leaves of stolon small often 5 mm. long 1 mm. broad lanceolate or linear-lanceolate longly acute, of upper leaves as much as 3·5 cm. long 5 mm. broad somewhat cucullate strict not recurving minutely ciliolate at base. Flower solitary terminal; pedicels about 5 mm. long. Calyx about 3·5 cm. long much shorter than corolla, 5-lobed.

[1] *Gentiana sino-ornata*, Balf. f.—Herba perennis diffusa stolonifera Stolones radicantes ramosi ad 18 cm. longi vel ultra a rosula centrali patentes. Folia stolonum epetiolata opposita vaginato-connata lineari-lanceolata vel a basi lanceolata longe acuta ad 3·5 cm. longa 5 mm. lata sursum concava. Flos solitarius terminalis; pedicellus brevis vix 5 mm. longus. Calycis tubus infundibularis haud dimidiatus circ. 1 cm. longus; lobi circ. 2 cm. longi lineari-acuminati erecti basi haud angustati. Corolla obconoideo-tubulosa ad 6 cm. longa vittata vittis flavido-albidis purpureo-suffusis et lineato-tinctis, intus emaculatis, fauce coerulea; lobis late ovatis acutis circ. 8 mm. longis intense coeruleis nitentibus; plicis circ. 3 mm. longis 8 mm. latis subcrenulatis vel dentatis. Filamenta staminum in parte libera circ. 1 cm. longa anguste alata coerulea; antherae sagittatae. Ovarium circ. 1·4 cm. longum; stipes circ. 2·2 cm. longus; stylus ad 7 mm. longus ramis stigmatiferis circ. 6 mm. longis recurvis.

Species Sectionis Frigidae a *G. Farreri*, Balf. f. et *G. Lawrencei*, Burkill foliis lineari-lanceolatis vel lanceolatis sursum concavis, florum colore intense coeruleo facile recognoscenda; a *G. Veitchiorum*, Hemsl. habitu diffuso foliisque sursum concavis recedens.

N.W. Yunnan.

tube funnel-shaped not split somewhat coriaceous about 1 cm. long or more 4 mm. in diameter reddened at the base outside; intracalycine membrane greenish-white truncate plane glossy; lobes subequal scarcely distant linear-acuminate hardly 2 cm. long 2 mm. broad flat not recurved not contracted at base green sometimes purpling at the tip. Corolla obconoid-tubular as much as 6 cm. long, spreading to about 3 cm.; tube within the calyx narrow yellowish-white, expanding upwards beyond calyx and showing on outside 5 broad bands (yellowish-white and suffused irregularly with purple) on the median of the petals (antipetaline), each band traversed by a central purple-blue line and having on each margin a dark-purple longitudinal ridge, inside transversely rugose without citron-yellow antipetaline spots, the interpetaline areas of a deep blue colour, glossy, throat blue; lobes broadly ovate acute apiculate about 8 mm. long and broad, half-spreading, outside traversed by the antipetaline bands, inside royal-blue-coloured glossy; folds slightly paler more or less oblique broadly triangular obtuse entire or somewhat crenulate or toothed about 3 mm. long 8 mm. broad. Free part of filaments of stamens about 1 cm. long tinted blue narrowly winged; stamens inserted about 2·5 cm. above base of corolla; anthers about 2·5 mm. long sagittate. Ovary about 1·4 cm. long; stipe about 2·2 cm. long; style as much as 7 mm. long its stigmatiferous branches about 6 mm long recurving.

E.N.W. Yunnan:—Summit of Mi Chang pass between River Yangtze and Chungtien plateau. Alt. 14,000–15,000 ft. Flowers deep blue. G. Forrest. No. 408. Sept. 1904.

E.N.W. Yunnan:—Lichiang Range. Eastern flank. Open mountain meadows. Alt. 11,000–12,000 ft. Lat. 27° 30′ N. Plant of 5–8 ins. Flowers bright blue, plicae green. G. Forrest. No. 6728. Sept. 1910.

E.N.W. Yunnan:—Summit of the Sungkwei pass. Stony open pasture. Alt. 12,000 ft. Lat. 26° 12′ N. Plant of 2–4 ins. Flowers deep clear blue, plicae yellowish-blue, striped and spotted. G. Forrest. No. 7374. Nov. 1910.

W.N.W. Yunnan:—Mekong-Salween divide. Alt. 12,000 ft. Lat. 28° 10′ N. Moist pasture. G. Forrest. No. 13,549. Oct. 1914.

The differentiation of closely allied species of Gentian from dried specimens is a task of some difficulty, and following the lead of Franchet,[1] who had described two Gentians collected by Soulié at and about Tungnglo in W. Szechwan as varieties of the Himalayan *G. ornata*, Wall. under the names *obtusifolia* and *acutifolia*, Forrest's dried earlier Yunnan specimens (under No. 408) of this plant were referred to *G. ornata*. Cultivation of plants (raised from seeds of later specimens under No. 6728) which flowered with Mr. Bulley at Ness and also at Edinburgh in 1912 showed that Forrest's plant was not the true *G. ornata*, and we named our plant a Chinese form of *G. ornata*. Under this designation Forrest's plant has passed out of the Royal Botanic Garden, Edinburgh, dropping sometimes in its spread the qualification "Chinese form," and appearing as *G. ornata*. Under the name *G. ornata* it received an Award of Merit at the Royal Horticultural Society when exhibited on October 12, 1915, by Mr. Amos Perry, who had obtained the plant from Edinburgh. It is not the Wallichian species, which is not now in cultivation, and perhaps never has been. I have not the material by which to form an opinion upon whether Forrest's plant is the same as Soulié's Szechwan plants.

[1] Franchet in Bull. Soc. Bot. Fr., xliii (1896), 493, where he says —

Gentiana ornata, Wall., Cat. 4386; C. B. Clarke, in Hook., Fl. of Brit. Ind., iv, 116; Bot. Mag., t. 6514 (forma micrantha).

Species in Se tchuen occidentali variabilis.

α Obtusifolia. -Folia inferiora et media oblonga, superiora lanceolato-linearia, omnia obtusa; flores 4–5 cent longi, caerulei cum vittis fuscis; plicae ovatae, obtusae

Les prairies humides, les pelouses fraîches à Tongolo, Tizou, etc. (R. P. Soulié). En thibetain: Aou meto (fleur du frère aîné).

β Acutifolia. - Folia media et superiora linearia, acuta vel acuminata; flores 6–8 cent. longi, anguste tubulosi, lobis margine intense violaceo-caeruleis, tubo cum vittis longitudinalibus atro-violaceis. Flores Gentianae striatae Maxim.

Depuis Tongolo jusqu'au village de Té la to, dans les bois et les lieux secs.

Je n'ai pas vu de la Chine la variété *micrantha*, Clarke, à petites fleurs et à feuilles courtes, récurvées.

Le végétation du *G. ornata* est la même que celle du *G. ternifolia*, Franch.; les stolons épigés ou hypogés s'enracinent à leur sommet d'où procède un bourgeon feuillé qui continuera la plante. Autour de ce bourgeon se développent deux ou plusieurs rameaux ascendants portant chacun une fleur. Dans toutes les formes de la plante la capsule est toujours très longuement stipitée, lancéolée, brièvement attenuée en style court.

The latter are certainly not *G. ornata*, Wall. I shall at the end of this communication deal with the question of the identity of *G. ornata*, Wall., and will add therefore nothing more here on the subject.

Until *G. Farreri* came, I gave the palm to *G. sino-ornata* amongst late-flowering Gentians. Nor do I admit that *G. Farreri* surpasses it at all points. The one is a pale the other a dark flowered species, and both should have a place in every garden.

G. sino-ornata is a late flowerer. The first flowers open usually at Edinburgh in the last days of September, and flowering continues until winter rigours send the plant to rest. It appears to be the most free in growth of the four species referred to here. A small plant from a cutting will increase to a patch a foot or more in diameter within a year. There is no mistaking it for any other species. Its half lanceolate pointed leaves, not narrowed at the base, which may be 5 millimeters broad, are stiff and spreading on the stolons and do not recurve as in *G. Farreri* and *G. Lawrencei*, and though they may approach the length of the leaves in those species, they look much shorter owing to their greater breadth The pedicel above the uppermost leaves hardly exists, so that the flower looks as if it were sessile on the end of the stolon and not stalked as in *G. Farreri* and *G. Lawrencei*. Then the calyx is much shorter than the corolla, its inner lining has a whitish vesicular appearance, and the calyx-lobes are erect—each of them is flat tapering from a non-contracted base about 3 millimeters broad to a sharp point. The corolla has a limb about 3 centimeters across when expanded, the throat is blotched inside and not bright white. The apiculate lobes do not reflex to the extent of those of *G. Farreri*, and the folds remain somewhat erect—the whole effect is that of a narrower and more funnel-like not trumpet-shaped mouth. The general colour of the corolla-limb is a rich royal-blue, in marked contrast to the satiny methyl-blue in *G. Farreri* and *G. Lawrencei*. The flowers show all the sensitiveness to light and moisture of most Gentians, only expanding fully under bright sunshine and in a dry atmosphere.

G. Veitchiorum is an altogether different plant in its

compact habit with blunter leaves. Its flowers are of a dark blue as in *G. sino-ornata*, but of a deeper blacker tint.

Gentiana Veitchiorum, Hemsl.[1] in Gard. Chron., 3; xlvi (1909), 178, fig. 74.

G. ornata, Hort. (not of Wallich).

G. ornata, var. *obtusifolia*, Franch. in Bull. Soc. Bot. France, xliii (1896), 493 (acc. to Hemsley).

G ornata, var. *Veitchii*, W. Irving in Gard. Chron., 3, lviii (1915), 288, fig. 100.

Perennial herb with thick roots and forming a central rosette from which spread many leafy stolons. Stolons

[1] Hemsley's description runs.—

Gentiana Veitchiorum, Hemsl.—Nova species ex affinitate *G. ornatae*, Wall. a qua differt foliis latioribus obtusis, calycis lobis subfoliaceis vix acutis, corollae amplioris lobis latis obtusiusculis et plicis inter lobos latis denticulatis. *G. ornata*, var. *obtusa*, Franch.:—Sinae occidentalis incola, legit. E. H. Wilson.

At least three different species of Gentiana have been, and perhaps are still, in cultivation under the name *ornata*, originally given by Wallich to a Himalayan species, which reaches almost to the upper limits of phanerogamic vegetation in that region. About the year 1880 a Gentian was cultivated in the Edinburgh Botanic Garden bearing this name, and was figured in the Botanical Magazine, pl. 6514, as such; but, as was pointed out by W. I. (Walter Irving) in the Gardeners' Chronicle, 1906, xl, p. 182, the plant represented is not the true *G. ornata* of Wallich. What it really is, is uncertain, and the history of its introduction into cultivation is apparently not on record. In 1883, the Gardeners' Chronicle published (ii, p. 396, fig. 60) an excellent illustration, reproduced in fig. 75, of the genuine *G. ornata* of Wallich, from specimens grown in the Wisley garden of the late Mr. Wilson. Turning to that, I find that it is a slender trailing plant with narrow, very acute leaves and very acute corolla-lobes, with narrow folds between A coloured figure of the same species was given in the Botanical Magazine for 1907, pl. 8140. Comparing the flowers actually figured in the Magazine with the type of Wallich's species in the Kew Herbarium, I think there is no doubt that it was correctly identified. Mr. J. Hutchinson, who contributed the description of that figure, suggests that the plant figured in the Botanical Magazine, pl 6514, is *G. nipponica*, but I have not time to follow up this suggestion.

Now comes a third Gentian, to which the name *ornata* has been attached. The species in question was exhibited by Messrs. James Veitch & Sons at the meeting of the Royal Horticultural Society on August 31, and received an Award of Merit. The history of it, is as follows:—In August 1906 Messrs. Veitch sent a plant of it to Kew for name, with the information that it was raised from seed collected by Mr. E. H. Wilson near Tatienlu, West China, at an elevation of 12,000 feet. It was identified with dried specimens collected by Père Soulié in the same region and described by Franchet (Bull. Soc. Bot. France, vol. xliii, p. 493), and named *Gentiana ornata*, var. *obtusifolia*. With all the material before me, I have no hesitation in accepting the identification; but I cannot agree in leaving it as a variety of *G. ornata*.

as much as 10 cm. long 2 mm. in diameter with cylindric internodes reddened more or less as much as 1·5 cm. long sometimes puberulous, prostrate at base ascending towards summit and ending in one flower or becoming arrested and forming a rooting rosette from which new stolons emerge. Leaves of upper part of stolon very shortly petiolate, opposite, thick somewhat fleshy, recurving about 2 cm. long 6 mm. broad above the connate vaginae of the nodal pairs, vaginal sheath about 4 mm. long or less adpressed to stem at mouth; lamina linear-oblong narrowed to the apex obtuse or acutish shortly mucronulate, margin finely scaberulous. contracted at the base into a very short petiole with somewhat membranous margins which are somewhat ciliate, upper surface dark-green somewhat glossy, on both surfaces minutely whitely papillate, lower surface paler with a slightly raised midrib; leaves of lower part of stolon ovate or elliptic or oblong always obtuse. Solitary terminal flower with a pedicel at most about 2 mm. long, reddened. Calyx about 3·3 cm. long much shorter than corolla, 5-lobed; tube funnel-shaped not split about 1·5 cm. long 4·5 mm. in diameter reddish at base outside, thin, intracalycine membrane yellow-green truncate somewhat vesicular white and membranous at the sinuses; lobes nearly equal about 1 cm. long 2 mm. broad linear-lanceolate acute and apiculate or mucronulate, in colour like the foliage-leaves, not recurved, at base contracted and there vesicular on upper surface. Corolla obconoid-tubular 5–6 cm. long; tube within the calyx greenish-white not tinted, expanded upwards showing outside 5 broad greenish-yellow bands (suffused faintly with purple) on median of petals (antipetaline), each band with a central keeled purple line and on each margin a broader similar ridge, the interpetaline areas deep purple, inside smooth with some purple antipetaline spots, throat black purple; lobes 5 broadly triangular or rather

Considering the large number of described Chinese species of which I have seen no authenticated specimens, there is some risk of duplication in proposing another, but that is the only course open under the circumstances.

G. Veitchiorum is a larger, more robust plant than *G. ornata*, with relatively broad, obtuse leaves, larger flowers, with broader corolla-lobes, and very broad toothed folds between them. The flowers are of an intense blue with light longitudinal bands on the outside.

trigonous apiculate about 7 mm. long and broad patent and recurving, traversed by the antipetaline bands outside, deep royal-blue inside; folds about 2 mm. long 4·5 mm. broad slightly paler blue with a triangular central obtuse tooth and slight erosion at the sides. Staminal filaments free from about 2·8 cm. above base of corolla, free portion about 1·2 cm. long pale violet and spotted, narrowly fringed; anthers sagittate about 2·8 mm. long. Ovary about 1·4 cm. long; stipe about 2·7 cm. long; style as much as 6 mm. long its stigmatiferous branches recurved 2 mm. long.

W. Szechwan. Wilson.

G. Veitchiorum is a fine garden plant, although not, I think, of the merit of *G. Farreri* and *G. sino-ornata*. It was introduced to cultivation, as Hemsley informs us, by Messrs. Veitch, who raised it from seed collected by E. H. Wilson in W. Szechwan. When describing it as a species distinct from *G. ornata*, Wall., Hemsley identified it as the plant which Franchet described under the name *G. ornata*, var. *obtusifolia*. Subsequently W. Irving gave it the name *G. ornata* var. *Veitchii*.

Without doubt Hemsley was right in giving the plant specific rank and separating it from *G. ornata*, Wall., which is a different plant. But the name *G. ornata* somehow got attached to it, and it received an Award of Merit at the Royal Horticultural Society on August 31, 1909, when shown by Messrs. Veitch under the name *G. ornata*. I may state here definitely that this plant so laureated was not the same as that which under the same name received an Award of Merit in 1915. Two species have been exhibited under the name *G. ornata* and each has received an Award of Merit. Neither of them is *G. ornata*, Wall. The plant shown in 1909 is *G. Veitchiorum*, that in 1915 is *G. sino-ornata*.

G. Veitchiorum may be distinguished at a glance from the three late-flowering species which I have already mentioned—*G. Farreri*, *G. Laurencei*, and *G. sino-ornata*—by its habit and foliage. It is a stiffer more compact grower, and the stolon early leaves are ovate or elliptic or oblong, contracted at base of lamina and blunt at the apex. The stolons themselves are thick with short internodes. The plant is, to our experience at Edinburgh, by no means

so free a grower as the others Its flower is dark blue, likest that of *G. sino-ornata* but darker in colour.

The following key may aid growers in distinguishing these Gentians in the garden :—

A. Diffuse plant. Stolons slender loosely and widely spreading up to 18 cm. long. Stolon-leaves epetiolate narrow linear or linear-lanceolate tapered to a long acute point, not contracted at base.

a. Flowers distinctly stalked, light blue with satiny sheen, throat white or pale blue and white

1. Stolon upper leaves dark green strongly recurved over 2 cm. long about 2 mm. wide at base. Pedicel above last leaf-pair about 1 cm. long dark red. Calyx-tube about 2 cm. long, lobes twice as long linear recurved not contracted at base. Corolla throat white, lobes somewhat apiculate bright satiny methyl-blue strongly recurving. Spread of corolla over 3 cm. . *Farreri*

2 Stolon upper leaves pale green erect hardly recurved over 2 cm. long about 1 mm. wide at base. Pedicel above last leaf-pair over 1 cm. long red. Calyx-tube about 1 cm. long or a little more, lobes twice as long filiform erect not recurved not contracted at base. Corolla throat lined pale blue and white, lobes obtuse pale blue hardly recurving Spread of corolla about 2 cm. . . . . . . *Lawrencei*

b. Flowers sessile or nearly so, throat dark pure blue.

3. Stolon upper leaves pale green strict spreading not recurved over 2 cm. long and 5 mm. wide at base. Pedicel above last leaf-pair nearly absent at most 5 mm. long. Calyx-tube about 1 cm. long, or a little more, lobes not twice as long linear flat somewhat spreading not recurved not contracted at base. Corolla-lobes apiculate royal-blue recurving. Spread of corolla about 3 cm. . . . . *sino-ornata*

B. Compact plant. Stolons stout short close. Stolon-leaves shortly petiolate linear-oblong or oblong obtuse or somewhat acute, contracted at base.

c. Flowers sessile or nearly so, throat dark purple-blue.

4. Stolon upper leaves dark green horizontal about 2 cm. long and 6 mm. wide. Pedicel hardly visible above last leaf-pair. Calyx-tube about 1·5 cm. long more or less, lobes shorter than or at most equal to tube erect not recurved contracted at base. Corolla-lobes apiculate deep purple-blue . . *Veitchiorum*

In the preceding pages I have made reference frequently to *G. ornata*, Wall., and have pointed out that three of the late-flowering species of which I furnish descriptions have been confused with it and received its name. It may be well, therefore, if I say something here about what *G. ornata*, Wall., really is and what it is not, and endeavour to clear up the confusion that attaches to the name.

G. ornata, Wall., is a plant obtained by Wallich from Gossain Than in Nepal in the years 1820–21. It appears in his Catalogue under No. 4386. Specimens of the Gossain Than plant are preserved in several public herbaria, of which Edinburgh is one, and the Wallichian specimens which we have are those upon which I rely for my knowledge of what *G. ornata*, Wall., is.

Wallich's plant was first fully described under the genus Gentiana by Grisebach [1] in 1839 and again in 1845.[2]

Previously, in 1838,[3] George Don had given a description of it as *Pneumonanthe ornata*. George Don does not refer to it as a garden plant, and we may assume that it was not in cultivation at the time of his writing.

In 1880 a plant was figured in the Botanical Magazine, t. 6514, under the name *G. ornata*, Wall. This plant came from the Royal Botanic Garden, Edinburgh. I have found no record of whence Edinburgh obtained it, but I am disposed to think that it was raised from seeds distributed from Calcutta. It was soon recognised that this plant was

[1] Grisebach, Gen. et Sp. Gentianearum (1839), 277. The following is Grisebach's description :—

Gentiana ornata, Wall.—Radix dense fasciculata, quasi nidum referens, epidermide versus apicem incrassata patula radicemque sacculi instar cingente. Caules plurimi 3–4-unciales, plerique fertiles, foliosi, declinati 1 adscendentes. Folia 8 longa, 1 lata, suprema longiora, cetera aequalia internodia aequantia, vagina apice ampliata. Calycis tubus patulus lobos aequans; lobi acuminati membrana intracalycina truncata prominula distantes. Corolla calyce duplo major, coerulea longitudinaliter striata; lobi acutissimi, mucronati, tubo 4plo breviores, plica obtusa duplo majores. Capsula oblongo-linearis, utrinque attenuata, corollam aequans. Semina oblonga, convexa, processibus scariosis asperrima, utrinque obtusa, nec alata.

Proxima inter nostrates *G. frigida*, Hk., a qua differet caulibus caespitosis, calyce, foliis summis majoribus, omnibus brevioribus, vagina foliari ampliata, flore solitario sessili etc. Cf. ad calcem generis *G. Kurroo*.

Gossain Than, Himalayah.

[2] In DC., Prod. ix (1845), 110.

[3] George Don, Gard. Dict., iv (1838), 194.

not the true *G. ornata.*[1] Hutchinson[2] suggests that it is near *G. nipponica*, Maxim.

C. B. Clarke[3] brought into Wallich's species the "abundant material" of Sikkim specimens collected by Sir Joseph Hooker and others, and cites the erroneous figure of the Botanical Magazine, t. 6514. I have not had opportunity to examine the specimens dealt with by Clarke, but I note an important phrase in his description: "Radical leaves 0 or inconspicuous at flowering time." Now that does not apply to Wallich's Gossain Than plants. Our specimens show a conspicuous leafy rosette with long leaves in the flowering plant. On the other hand, the description does fit Sikkim plants (and I may add Bhutan ones), of which we have specimens. In them a leafy "radical" rosette is apparently not formed. Of this I shall write something later. Here I will only say that I suspect some—shall I say much?—of the Sikkim material is not *G. ornata*, Wall. Of the var. *meiantha* which Clarke regards as a "very dubious plant," I can say nothing.

In the same year (1883) as the Gentianaceae of Hooker's Fl. of Brit. Ind. appeared, there was published over the name *G. ornata* in the Gardeners' Chronicle[4] a figure of a plant grown by Mr. Wilson at Wisley—probably from Calcutta seed. The plant is not *G. ornata*, Wall. The tuft of short ascending potential stolons in the centre of the far-spreading flowering stolons is not a character of *G. ornata*, but is found in another species of Gentian which extends from Sikkim into Bhutan. I shall describe presently this species under the name *G. prolata*. The construction to which I call attention is of biological import. It means that the stolons are biennial. The dried specimens of Wallich's Nepal *G. ornata* show annual stolons. I am disposed to interpret the figure as a representation of *G. prolata*. It cannot be *G. ornata*, Wall.

In 1896 the first Chinese plants to be identified with *G. ornata*, Wall. were described by Franchet.[5] On p. 255

[1] Later pointed out in Gard. Chron., 3, xl (1906), 182, and again 3, xlvi (1909), 178.
[2] Hutchinson in Bot. Mag. (1907), t. 8140.
[3] Clarke in Hook., Fl. Brit. Ind., iv (1883), 116.
[4] Gard. Chron., 3, ii (1883), 396, fig. 60.
[5] Franchet in Bull. Soc. Bot. France, xliii (1896), 493.

is quoted what Franchet says. Some specimens collected by Soulié at and near Tungnglo, Franchet referred to *G. ornata*, Wall. (taking that species in the sense of C. B. Clarke), as varieties—one *G. ornata*, var. *obtusifolia*, the other var. *acutifolia.* I have pointed out elsewhere that Franchet, in his pioneer work on the Western Chinese Flora, was cautious and conservative, preferring to aggregate Chinese forms with Indian types rather than to segregate. This is an example. I have seen specimens of both the varieties, though I have not had opportunity to examine them critically, and in the light of our increased knowledge it is certain that neither is the typical *G. ornata*, Wall. Whether they are to be identified with any of the forms I have already spoken of in this paper I cannot say. Hemsley[1] is perhaps right in identifying the var. *obtusifolia* with his *G. Veitchiorum*.

Kusnezow[2] (1904) follows C. B. Clarke, but concludes that *G. ornata*, Wall. is a variable species The plant of the Bot Mag., t. 6514, may be a special variety. He cites the figure in the Gardeners' Chronicle for 1883 as *G. ornata.*

In 1907 there appeared in the Bot. Mag., t. 8140, an illustration with the name *G. ornata*, Wall. The same plant is referred to in the Gard. Chron. for 1906.[3] I have already (p. 252) written of this, but will repeat here in order to complete my notes of *G. ornata.* Hutchinson, who writes the text to the figure, gives the story of the plant. It reached Kew in 1905 from Max Leichtlin. This is the history of the plant which flowered with Sir Trevor Lawrence in 1905, and is described and figured by Burkill[4] as *G. Lawrencei.* A plant came to Edinburgh from Max Leichtlin in the same year, and it is *G. Lawrencei.* The Bot. Mag. figure is certainly not a representation of *G. ornata*, Wall. It represents, I believe, *G. Lawrencei.*

In the same year George Forrest published[5] an account of some Gentians he had collected in Yunnan, and accepting Franchet's recognition of *G. ornata*, Wall., as a West Chinese species, assigned to it the plant which is described

[1] Hemsley in Gard. Chron., 3, xlvi (1909), 178, fig. 74.
[2] Kusnezow in Acta Horti Petrop., xv (1904), 268.
[3] Gard. Chron., 3, xl (1906), 182.
[4] Ibid., 3, xxxviii (1905), 307, fig. 119.
[5] G. Forrest in Notes Roy. Bot. Gard. Edin., iv (1907), 71.

on a preceding page as *G. sino-ornata*, and this plant, as I have explained, is one of those which in cultivation often bear the name *G. ornata*.

Hemsley[1] in 1909, when describing Wilson's Szechwan plant, raised by Veitch, as *G. Veitchiorum*, concludes that his plant is *G. ornata*, var *obtusifolia*, Franch. As I have previously said (p. 259), Hemsley was right in giving this plant specific rank.

Then in 1915 Irving,[2] in the text attaching to a figure of *G. Veitchiorum*, Hemsl., whilst agreeing with Hemsley that this *G. Veitchiorum* is *G. ornata*, Wall., var. *obtusifolia*, Franch., maintains that *G. ornata*, Wall. does extend into China, that *G. Veitchiorum* is only a variety of Wallich's type, and that the same plant was laureated by the Royal Horticultural Society in 1909 and in 1915. As the Franchetian varietal name *obtusifolia* is already attached to another species, Irving renames *G. Veitchiorum*, calling it *G. ornata*, var. *Veitchii*. But *G. ornata*; Wall. does not extend into China. *G. Veitchiorum* is a distinct species. The plants which received Awards of Merit in 1909 and in 1915 under the name *G. ornata* were not the same. The 1909 plant was *G. Veitchiorum*. The 1915 plant was *G sino-ornata*.

From this history it will be learned that the name *G. ornata*, Wall. has been attached at different times to plants coming from Nepal and Sikkim on the West, Yunnan and Szechwan on the East, and Baikal and N. Mongolia on the North I know it for certain only in Wallich's Nepal specimens, but it possibly occurs also in Western Sikkim. From amongst the forms that have been included in it we can segregate these species:—*G. Lawrencei*, *G. prolata*, *G sino-ornata*, *G. Veitchiorum*, and the unidentified plant of the Bot. Mag., t. 6514.

The following is a description of *G. ornata*, Wall., based upon the plants from Gossain Than:—

Gentiana ornata, Wall. Cat., 4386; Griseb. Gen. et Sp. Gentianearum (1839); id. in DC., Prod., ix (1845), 110.
G. ornata, Clarke in Hook., Fl. Brit. Ind., iv (1883), 116. Nepal plant only.

[1] Gard. Chron., 3, xlvi (1909), 178, fig. 74. See p. 257 of this paper
[2] Ibid., 3, lviii (1915), 288, fig. 100.

G. ornata, Kusnezow in Acta Horti Petrop., xv (1904), 268. Nepal plant only.

Pneumonanthe ornata, George Don, Gard. Dict., iv (1838), 194

Excluded are:—

G. ornata of Bot. Mag. (1880), t. 6154.

G. ornata of Gard. Chron., 3, ii (1883), 396, fig. 60.

G. ornata, var. *acutifolia*, Franch. in Bull. Soc. Bot. France, xliii (1896), 494.

G. ornata, var. *obtusifolia*, Franch. in Bull. Soc. Bot. France, xliii (1896), 493.

G. ornata of Gard. Chron., 3, xl (1906), 182, and of Bot. Mag. (1907), t. 8140.

G. ornata, G. Forrest in Notes Roy Bot. Gard. Edin., iv (1907), 71.

G. ornata, var. *Veitchii*, W. Irving in Gard. Chron., 3, lviii (1915), 288, fig. 100.

A perennial herb with a very short rhizome crowning the long fleshy roots and producing a close rosette, conspicuous at the flower-period, of linear somewhat fleshy leaves as much as 2·5 cm. long and 2 mm. broad, acute at the apex and expanding at base into a wide vagina connate with that of the opposite leaf to form a sheath. From the rosette radiate many prostrate short branches (at most about 5 cm. long) which ascend at the point and end in a solitary sessile flower. Stem of the shoots thin about 1 mm. in diameter, longest internodes about the middle and there about 0·5 cm. long, slightly tinted red. Leaves at base of shoots with an oval lamina about 4 mm. long and 2 mm. broad somewhat fleshy, obtuse or acute, slightly cartilaginous and obscurely scaberulous at the margin, at the base contracted into a short parallel-sided petiolar portion about 1 mm. long, which expands into a vagina connate with that of the opposite leaf to form a membranous (when dry) sheath about 2 mm. long open at the mouth; leaves at the top of the shoot with a linear-lanceolate lamina about 1·2 cm. long and 3 mm. broad shortly mucronulate, margin thinly cartilaginous and obscurely scaberulous, contracted at base into a petiolar portion about 1·5 mm. long, vaginal sheath of the leaf-pair about 3 mm. long membranous and open at top. Flower sessile

varying in size. Calyx (in larger flower) about 2·4 cm. long; tube funnel-shaped not cleft reddish outside about 1·4 cm. long somewhat thin not rugose inside, intracalycine membrane truncate, 5-lobed; lobes about 1 cm. long and 1 mm. broad subequal narrow linear acute, margin slightly cartilaginous and obscurely scaberulous, not contracted at base, intersepaline sinus about 1·75 mm. broad. Corolla clavate (in larger flower) 4·3 cm. long (but sometimes only 3 cm.) striate outside with broad bands along middle of petals, each band with three equidistant coloured lines (no trace of spots in dried specimen); tube within the calyx about 2 mm. in diameter, ampliate above and 5-lobed; lobes about 6 mm. long and 5 mm. wide at base broadly triangular acute and mucronulate erect or only slightly spreading in flower; folds broad about 7 mm. across, one-fifth or one-quarter the length of the lobe with a central more or less triangular tooth and elsewhere more or less erose or slightly toothed. Stamens (in larger flower) free from about 1 cm. above base of corolla, free portion about 1·2 cm. long narrowly winged; anther about 3 mm. long. Gynaeceum shorter than stamens; stipe longer than ovary; ovary linear fusiform.

Nepal. Gossain Than.

On a previous page (p. 262) I have stated that some of the Sikkim material (more or less) placed in *G. ornata*, Wall., belongs to a distinct species which I name *G. prolata*, of which the fig. 60 in the Gard. Chron. (3, ii (1883), 396) is a representation. This will be found to be, I believe, a type not uncommon in Sikkim, and it certainly extends into Bhutan. I have been able to study this plant in living flowering specimens raised from seed obtained in Sikkim by Cave and in Bhutan by Cooper. Cave's seeds came under the name *G. ornata*. The following is a description of this species:—

Gentiana prolata, Balf. f.[1]

G. ornata, Hort. in Gard. Chron., 3, ii (1883), 396, fig. 60.

[1] *Gentiana prolata*, Balf. f.—Herba perennis stolonifera. Stolones eradicantes ramosi biennes a rhizomate multicipite centrali erosulato ad 18 cm. patentes. Folia breviter petiolata opposita vaginato-connata,

G. ornata, Clarke in Hook., Fl. Brit. Ind., iv (1883), 116, in part.

G. ornata, Kusnezow in Acta Horti Petrop., xv (1904), 268, in part.

A perennial herb with a copiously branched root-system, the main branches somewhat thick and fleshy, crowned by a multicipital rhizome which does not form a leaf-rosette but emits many erect stout leafy shoots in a central cluster which become prostrate towards the end of first year's growth but do not root, and after elongation in their second year to as much as 18 cm. turn upwards and end each in a single sessile flower. Each branch may be simple or towards the end bear some (4–5) short lateral upturned branches each of which ends in a solitary sessile flower. At time of flowering of the prostrate shoots the shoots to flower in following year are conspicuous. Shoots bear decussate leaves from base upwards; the internodes at base of whole shoot and of beginning of second year's growth shorter, the longest internodes about 1 cm. long. Leaves more or less thick succulent connate in pairs by the vaginae to form a closely adpressed scaberulous sheath round the stem; lower leaves of the shoot smaller, lamina in the smaller lower leaves elliptic about 4 mm. long by 2 mm. broad or larger, in the larger upper ones lanceolate or oblong about 1·4 cm. long and 5 mm. broad, apex obtuse with very short mucro, margin slightly cartilaginous and scaberulous, base slightly contracted to a broad membranous parallel-sided petiole about 1 mm. long in the smaller leaves, 2 mm. in the larger, passing into the leaf-sheath, surfaces with stomatic punctulations. Calyx about 1·5 cm. long (after flowering larger) entire, tube obconoid-tubular often reddened outside about 1 cm. long or less somewhat thin

infera elliptica, supera lanceolata vel oblonga obtusa ad 1·4 cm. longa 5 mm. lata basi contracta. Flos solitarius terminalis sessilis. Calycis tubus infundibuliformis haud dimidiatus circ. 1 cm. longus; lobi dimidio breviores oblongi acuti basi haud contracti. Corolla clavata 3·5–4 cm. longa extus vittata vittis 3-lineatis pauci-maculatis, fauce purpureo-suffusa; lobis late triangularibus vel ovatis circ. 3 mm. longis pallide coeruleis; plicis circ. 2 mm. latis sub-erosis et dentatis. Filamenta staminum in parte libera circ. 8 mm. longa purpurea anguste alata; antherae sagittatae. Ovarium vix 1 cm. longum; stipes circ. 2 cm. longus; stylus circ. 2 mm. longus ramis stigmatiferis circ. 1 mm. longis recurvis.

Sikkim; Bhutan.

not rugose inside, intracalycine membrane truncate; lobes 5 subequal about 5 mm. long or a little longer by about 1·5 mm. broad oblong acute, shortly apiculate not contracted at base, intersepaline sinus under 0·5 mm. broad seldom more, margin scaberulous. Corolla 3·5–4 cm. long clavate; tube within calyx very narrow about 1·5 mm. in diameter ampliate upwards and 5-lobed, purple striate outside on a yellowish ground having 5 bands one along middle of each petal, bands marked by 3 purple equidistant lines and a few spots; lobes and folds blue erect hardly spreading; lobes broadly triangular or ovate about 3 mm. long and 3 mm. broad at base slightly apiculate, folds about 2 mm. broad showing a central tooth about 0·25 mm. high and slight erosion at its sides. Stamens free from about 18 mm. above base of corolla, free filament purple narrowly winged about 8 mm. long; anther 1·5 mm. long sagittate. Gynaeceum about 3 cm. long; ovary fusiform not 1 cm. long stipitate; stipe about 2 cm. long; style about 2 mm. long stigmatiferous through about half its length and there recurved. Capsule about 1·5 cm. long oblong, but slightly tapered to the ends, far exserted from corolla on a stipe as much as 5 cm. long. Seeds ovoid about 1 mm. long by 0·5 mm. broad with straw-coloured alveolar testa.

Bhutan. Parsheng, Timpu. Alt. 14,000 ft. Cooper. No. 3499. 27th October 1914.

Sikkim. Kapup. Cave. 31st October 1916.

G. prolata flowered at Edinburgh in 1917. The plants were raised from seeds taken from Cooper's Bhutan specimens. This was not the first flowering at Edinburgh. In the nineties of last century plants were raised and flowered from Calcutta seed which came with the name *G. ornata*.

The habit of the plant is very different from that of *G. ornata*, Wall., as that appears in the type-specimens. A plant of *G. prolata* in flower shows a central tuft of several erect branches 5 or 6 cm. long, with short more or less elliptic bright green leaves springing from a common many-headed rhizomatous axis from which descend the much-branched roots which are somewhat thick at their point of origin. The base of each of these shoots begins with some scale-leaves. Spreading out from these and arising

from the same rhizomatous axis are several decumbent non-rooting stolons some 18 cm. or so long which are unbranched through about two-thirds of their length and bear a few branches in about the upper third. Upon the unbranched portion two regions are to be recognised—a lower, which may be half the length of the whole, less or more, is clad with small more or less elliptic straw-coloured or brown withered leaves, the upper bears larger green fresh leaves increasing in size upwards and without interruption into the branched region where they are larger than elsewhere. The limit between the lower and upper regions of this unbranched portion is clearly marked by the leafage, for at the point of junction the leaves are particularly small often appearing almost as scale-leaves; and then there is the contrast between the withered and fresh leaves. The junction marks the limit between the growth of two successive years Each of these stolons shows two years' growth. The leaves of the first year's growth are withered, those of the second are green and active and the portion of stolon bearing them ends itself in a solitary flower and gives origin from the leaves immediately beneath this terminal flower to some 4 or 5 or more lateral short leafy curvingly ascending shoots each in the axil of a leaf and ending in a solitary flower The flower terminating the stolon expands first, the lateral ones expand in succession from below upwards and we have a typical definite racemose branching. Normally only one leaf of each pair in dextrorse sequence gives origin to an axillary flower-branch. Sometimes in vigorous stolons some of the leaves lower down upon this green leafy part of the stolon may form axillary buds. These are weak vegetative shoots which do not reach an advanced stage of development.

After flowering and at the end of the vegetative season the whole of these branched stolons die back to the base—crisply desiccating not soddenly rotting—and remain attached to the rhizomatous axis around the group of green shoots in the middle. These green shoots have by this time altered their direction. They are now nearly in or are approaching the prostrate lie, their growth in length is arrested, the ultimate leaves being very small, but I do not

find anything of the nature of a scale-leaf bud. It is a green-leaf bud. In this condition they remain during the winter period of rest as incipient stolons. Some of the basal leaves wither, but there is always a group of green leaves at their top. These are perennating stolons.

The recurrence of the active vegetative period sees two developments in these stolons—one at their base, one at their apex. At their base buds in the axils of the lowermost scale-leaves grow out as erect green shoots and eventually form the central tuft which is so conspicuous at the flowering period of the plant. At their apex growth in length is resumed and a longer portion is added which forms the green leafy flowering termination to the stolon.

Thus the features of the plant in flower are explained. The long flowering stolons are biennial. The demarcation of the lower and upper regions in the unbranched area of the stolon indicates, as I have said, the limit between a first year's growth and a second year's growth. The green erect shoots of the tuft in the middle of the spreading stolons are the stolons in their first year of growth. Branching of the one-year-old stolons is limited to the base—to the formation of new stolons. Branching of the two-year-old stolons is limited to the apex—to the formation of flower-shoots. The long intermediate region is unbranched. The bases of all the stolons go naturally to the formation of the short rhizomatous axis of the plant, and possibly latent buds may exist or new buds may form at the base of flowered stolons, but I do not know if this is the case. But there is not found on the central rhizomatous axis a rosette of conspicuous green linear and pointed leaves standing up above the bases of the flowering stolons.

In contrast with this construction in *G. prolata*, I find in *G. ornata*, Wall., at flowering time a central rosette of many linear pointed leaves—radical leaves of many systematic descriptions—crowning the roots which are thick at their origin, branching freely as they pass into the soil. Spreading out from this rosette are short, non-rooting stolons, each ending in a solitary flower. I see no trace of biennial growth upon them. They suggest annual growths.

Not having living specimens of *G. ornata*, Wall., I cannot write with the same certainty of its life-history as I can of

G. prolata, of which living plants are before me. But one has only to put side by side Wallich's Gossain Than dried specimen of *G. ornata* and specimens of the Sikkim plant which I am calling *G. prolata* to recognise that the whole habit and growth in the two plants is quite different and that they are different species.

I cannot say whether *G. prolata* is to prove a free-growing hardy garden plant or not. It will certainly never rival those great acquisitions to our gardens—*G. Farreri* and *G. sino-ornata*. Were I limited to two blue-flowering autumn species these are the two I would select.

The following is a summary of the results of my analysis of the nomenclature and figures of these Gentians that are under review :—

G. Farreri, Balf. f. Kansu species.
  In cultivation.
G. Lawrencei, Burkill. Siberian species.
  In cultivation.
  Is the *G. Lawrencei* of Gard. Chron., 3, xxxviii (1905), 307, fig. 119.
  Is the *G. ornata* of Gard. Chron., 3, xl (1906), 182.
  Is the *G. ornata* of Bot. Mag. (1907), t. 8140.
G. ornata, Wall. Nepal species.
  Not in cultivation. Probably never has been
  Is the *G. ornata* of Hook., Fl. Brit Ind , iv (1883), 116. Nepal plant.
  Is the *G. ornata* of Acta Horti Petrop., xv (1904), 268. Nepal plant.
G. ornata, var. *acutifolia*, Franch. Szechwan form.
  Is not *G. ornata*, Wall.
G. ornata, var. *obtusifolia*, Franch. Szechwan form.
  Is not *G. ornata*, Wall.
  May be *G. Veitchiorum*, Hemsl.
G. prolata, Balf. f. Sikkim and Bhutan species.
  Is in cultivation and has been more than once previously in cultivation.
  Is the *G. ornata* of Gard. Chron., 3, ii (1883), 396, fig. 60.
  Is the *G. ornata* of Hook., Fl. Brit. Ind., iv (1883), 116. Sikkim plant (? all).
  Is the *G. ornata* of Acta Horti Petrop., xv (1904), 268. (Except Nepal plant.)
G. sino-ornata, Balf. Yunnan species.
  In cultivation.
  Is the *G. ornata* of Notes R.B.G. Edin., iv (1907), 71.
  Is the *G. ornata* which received Award of Merit, Royal Horticultural Society, Oct. 12, 1915.
G. Veitchiorum, Hemsley. Szechwan species.
  In cultivation.
  Is the *G. Veitchiorum* of Gard. Chron., 3, xlvi (1909), 178, fig. 74.
  Is the *G. ornata* var. *Veitchii* of Gard. Chron., 3, lviii (1915), 288, fig. 100.
  Is the *G. ornata* which received Award of Merit, Royal Horticultural Society, Aug. 31, 1909.

FIGURES.

G. Laurencei of Gard. Chron., 3, xxxviii (1905), 307, fig. 119 . .	= *G. Laurencei*, Burkill.
G. ornata of Bot. Mag. (1880), t. 6514	= Uncertain what the figure represents.
G. ornata of Gard. Chron., 3, ii (1883), 396, fig. 60	= *G. prolata*, Balf. f.
G. ornata of Bot. Mag. (1907), t. 8140	= *G. Laurencei*, Burkill.
G. ornata, var. *Veitchii* of Gard. Chron., 3, lviii (1915), 288, fig. 100 . .	= *G. Veitchiorum*, Hemsl.
G. Veitchiorum of Gard. Chron., 3, xlvi (1909), 178, fig. 74	= *G. Veitchiorum*, Hemsl.

ENVOY.

The name *Gentiana ornata* should be dropped out of the literature of gardens. It is not in cultivation. Probably never has been. The place which its attractive name seems to claim for it is now occupied by much finer Chinese species.

THE GENUS NOMOCHARIS.

By Professor BAYLEY BALFOUR, F.R.S.

(Read February 14, 1918.)

Of the many remarkable plants which recent exploration of Western China has brought to our knowledge, none take precedence over those which Franchet included in his new genus Nomocharis. They are liliaceous, and occupy a position in the family between Lilium itself and Fritillaria. In that area are several plants whose relationship with Lilium on the one hand and Fritillaria on the other are subjects of discussion, and if Nomocharis adds another to this group of forms, it also brings information which throws light upon the affinities of debatable species. Franchet named only one species—*N. pardanthina*—when he described the genus Nomocharis, and by way of introduction to what I am to say about the genus, I give hear a translation of Franchet's description of both genus and species:—

Nomocharis, Franch.[1]

'Perianth deciduous, segments spreading dissimilar; calycine segments ovate, shortly acuminate, quite entire,

[1] Franchet in Journ. de Bot. iii (1889), 113. Franchet's words are :—*Nomocharis.* Perianthium deciduum, segmentis patentibus dissimilibus, calycis segmenta ovata, breviter acuminata, integerrima, foveola destituta; petala late ovata, margine dentato-fimbriata, basi foveolata; foveola magna, flabelliformis, e medio a limbo soluta, multifida, lobis oblongis incisis; stamina 6, basi segmentis breviter coalescentibus illisque duplo breviora; filamenta inferne circiter ad medium usque inflato-claviformia, parte inflata cava apice rotundata, exinde subulata; antherae oblongo-ovatae, medio dorsofixae, e latere longitudinaliter dehiscentes; discus tenuis, annularis, integer, parvus; ovarium sessile, ovato-oblongum, triloculare, loculis multiovulatis; stylus capsulae subaequilongus, apice paulo incrassatus, stigmate obscure trilobo; capsula ignota.

Bulbus squamosus, squamis albidis oblongis, carnosis, imbricatis; fibrae radicales crassae, nunc fusiformes, villosae; caulis pedalis vel paulo ultra; folia lanceolata, sparsa vel 3–6 verticillata; flores 1 vel 3–4 axillares, speciosi, virginei subnutantes; sepala pallide rosei, saepius immaculati; petala rubescentia, maculis violaceis conspersa, foveola nigro-purpurea

Genus inter Lilium et Fritillariam medium; bulbi indole, antheris dorsofixis styloque Liliis vere affinis; petalis foveolatis ad Fritillariam vertitur. Ab utroque genere differt: staminum filamentis parte inferiore inflatis, cavisque; foveola multifida et semilibera, quod in nullo

destitute of foveola; petaline segments broadly ovate, margin dentate-fimbriate, foveolate at base; foveola large, fan-shaped, forming a free limb above the middle, much cleft, lobes oblong, incised; stamens 6, slightly adhering to the base of the perianth-segments and one-third their length; filaments from base to the middle inflated-club-shaped, inflated portion hollow, rounded at summit, beyond the inflated portion subulate; anthers oblong-ovate, dorsifixed at the middle, dehiscing longitudinally at the sides; disk thin, annular, entire, small; ovary sessile, ovate-oblong, trilocular, loculi many-ovuled; style about equalling in length the ovary, apex slightly thickened, stigma obscurely trilobed; capsule unknown.

"Bulb squamate, scales whitish oblong, fleshy, imbricate; root-fibres thick, sometimes fusiform, villous; stem a foot high or a little more; leaves lanceolate, sparse or 3–6 in a whorl; flowers 1 or 3–4 axillary, showy, slightly nodding; sepals pale rose, more often unspotted; petals rubescent, sprinkled with violet spots, foveola black-purple.

"Genus midway between Lilium and Fritillaria; truly related to Lilium by the nature of the bulb, dorsifixed anthers,

genere affini observatum; perianthii lobis exterioribus et interioribus dissimilibus, omnibus late patentibus.

N. pardanthina.—Yun-nan, in pascuis montis Koua-la-po, supra Hokin; fl. 2 jun. 1883 (Delavay, no. 257).

Le tubercle est formé d'écailles étroites, charnues, comme celui de certain Lis; dans les individus grêles les feuilles sont ordinairement éparses et la fleur solitaire. Les individus robustes, atteignant jusqu'à cm. 60, ont presque toujours les feuilles verticillées par 4–6, sauf les inférieures et les supérieures, et ils ont jusqu'à 4 fleurs larges de 6-8 cent.; ces fleurs sont très ouvertes; leur divisions étalées horizontalement présentent la particularité singulière d'être nettement dissemblables. Les 3 externes ovales, entières sur les bords, sont le plus souvent dépourvues de macules violacées; les 3 intérieures largement ovales, à bords dentés-fimbriés, parsemées de taches d'un pourpre brun, offrent en outre à leur base une large macule d'un pourpre foncé en partie recouverte par une écaille flabelliforme qui est libre dans sa moitié supérieure et divisée jusqu'au milieu en 5–8 lobes étroits, élargis et lobulés au sommet.

Les filets staminaux sont très remarquables par le renflement de leur portion inférieure, obovale-claviforme, creuse et à parois très minces, arrondie au sommet et surmontée par une pointe subulée qui porte l'anthère insérée par le milieu du dos.

Cette charmante Liliacée, qu'on peut espérer voir cultiver un jour, fait l'ornement des pâturages à sol calcaire de la montagne de Koua-la-po, dans le district de Tali, où elle végète parmi les herbes, à la manière des Lis.

and the style; inclining to Fritillaria by the foveolate petals. From both genera it differs by: the hollow inflated lower part of staminal filaments; the much-cleft and half-free foveola, which is seen in no allied genus; the dissimilar outer and inner lobes of the perianth, which are all widely spreading.

"*N. pardanthina*, Franch.

"Yunnan:—In pastures of Mt. Koua-la-po, above Hokin; fl. 2 Jun. 1883 (Delavay, No 257).

"The tubercle is formed of straight, fleshy scales like those of certain lilies; in weak individuals the leaves are ordinarily scattered and the flower solitary. Robust individuals reach as much as 60 cm. in height, have the leaves almost always in whorls of 4–6, excepting the lower and upper ones, and have as many as 4 broad flowers of 6–8 centimeters; these flowers are very open; their divisions stretched out horizontally present the singular feature of being markedly dissimilar. The 3 outside ones are oval, entire, and more often without violet spots; the 3 inside ones, broadly oval, toothed and fimbriate, and sprinkled with purple-brown spots, have at their base a large blotch of a deep purple colour in part covered by a fan-shaped scale which is free in its upper half, and divided as far as the middle into 5–8 lobes expanded and lobulate at the top.

"The staminal filaments are very remarkable by the voluminous expansion of their lower portion, which is oboval-club-shaped, hollow with thin walls, rounded at the summit and surmounted by a subulate point which bears the anther inserted by the middle of its back.

"This charming liliaceous plant, which one may hope to see in cultivation one day, is an ornament of the pastures on the calcareous soil of Mount Koua-la-po in the district of Tali, where it grows amongst herbs after the fashion of a lily."

Franchet's expectation has been realised. *N. pardanthina* flowered in the Royal Botanic Garden, Edinburgh, in 1914, in plants raised from seeds collected by George Forrest (No. 5816) for Bees Ltd., some of which were generously presented to us. The plant was exhibited on 6th June 1916

at the Royal Horticultural Society, where it was awarded a First Class Certificate. It is a beautiful plant, and well worthy of cultivation for itself. If it takes in hybridisation, it should originate a remarkable race of garden plants. The habit certainly suggests Lilium rather than Fritillaria. How far that is borne out by analysis and comparative investigation will be set forth in what follows here.

Before passing to this, I must say something of other known forms of Nomocharis.

Shortly before our plant of 1914, which had rose-coloured flowers, opened its blooms, a plant of the genus Nomocharis, raised from seeds also collected by George Forrest, flowered at Edinburgh in one example only, producing a large open flower with a white ground spotted maroon all over both sepaline and petaline segments, recalling, indeed, the colouring of the more spotted varieties of *Odontoglossum crispum* In addition, the petaline segments at base were blotched a deep purple-red. From this flower we were fortunate in obtaining seeds– most fortunate, indeed, because by one of these accidents to which in these days we are particularly liable our old plants, both of it and of *N. pardanthina*, were destroyed. In Forrest's dried collections there are specimens of this Nomocharis with white and spotted flowers under Nos 3845 7160, and 11,624, the flower in 7160 being by far the finest. On his field-tickets Forrest describes the flowers as "satiny white" or "watery white" and spotted, and he also says they are fragrant. (Amongst his specimens is also one under No 3844, of which he writes, "variety with flowers pure white," and the solitary flower bears out the description, showing no spots.) Without doubt a Nomocharis, this plant seems to be a different species from Franchet's *N. pardanthina*, and the description which I give of it here under the name *N. leucantha* tells the difference between them.

N. leucantha, Balf. f.[1]

Bulb scaly narrowly ovate pointed about 3 cm. long and 1·5 cm. in diameter. At flowering time coated outside with

[1] *Nomocharis leucantha*, Balf. f.—Bulbus anguste ovato-oblongus, squamis carnosis acuminatis. Caulis ad 75 cm. altus. Folia ad medium 3–6-verticillata infra et supra per paria disposita, infima sparsa, lanceo-

mucilaginously rotting remains of 3-year-old and older scales; chief scales of the bulb 5–6 2-year-old fleshy straw-coloured ovate tapering to a membranous erose decapitated summit adpressed connivent more or less surrounding withered base of stem of their year and enclosing flowering stem enwrapped in shorter 5–6 scales of the year which have fleshy bases and membranous top acute or obtuse. Roots somewhat fleshy. Stem as much as 75 cm. long and 5 mm. in diameter below first green leaves, above the bulb tuftedly rooting after fashion of lilies, bare of green leaves below over as much as 28 cm. and bearing there one or two sparse distant strap-shaped blunt mucronate scale-leaves. Green leaves in distant (often 7·5 cm.) whorls of 3–6 after a first solitary leaf often followed by a pair, at summit sometimes in pairs, lanceolate or rarely lower ones oval-lanceolate long-acuminate with a sharp point, as much as 9·5 cm. long 2·4 cm. broad, conspicuously 3-nerved with subsidiary intermediate parallel nerves, olive-green above, beneath paler somewhat glaucous. Flowers 2–3 distant racemose axillary to one leaf of uppermost whorls, pedicels stiff straight, at apex thickened and there nodding, slightly shorter than axillant leaf, spreading nearly horizontal. Perianth open spreading as much as 9 cm. in diameter; segments "watery" or satiny white all equal in length and spotted pale purple or crimson-maroon, petaline with deep purple-red 2-lobed basal blotch about 6 mm. long, sepaline segments with small median basal purple blotch and faint midrib eglandular, ovate as much as a little over 4 cm. long about 2 cm broad, shortly acuminate ending in darker sometimes swollen tip, acuminate apex ciliate-fringed rest of margin entire eciliate, petaline nearly orbicular with prominent midrib as much as 3·5 cm. broad abruptly

lata longe acuminata ad 9·5 cm. longa 2·4 cm. lata papyracea, supra atroviridia subtus glauca. Flores distantes in racemum 2–3-florum laxe dispositi; pedicelli stricti patentes apice nutantes. Perianthum aperte patens ad 9 cm. diam. albidum nitens maculis pallide-purpureis vel kermesinis et raro rufescente basali notatum; segmenta inaequalia dissimilia, calycina eglandulosa ad 4 cm longa 2 cm. lata breviter acuminata, apice obscure fimbriata, petalina suborbicularia ad 3·5 cm. lata abrupte acuminata, costa media prominula, margine superne dentato-fimbriata, basi biglandulosa glandula quaque labio inciso flabelliformi cristata Stamina circ. 1·6 cm. longa ovarium subaequantia; filamenti pars inflata ad 9 mm. longa, apex subulatus ad 3 mm. longus; antherae circ. 8 mm. longae ad 3 mm. supra basin dorsifixae.

acuminate at summit and there ciliate-fringed, downwards through one half or more dentate-fringed, entire below, base with two nectar-glands one on each side of midrib, each covered by a fan-shaped incised or crested dark purple-red flap. Stamens about 1·6 cm. long; swollen base of filament deep purple about 9 mm. long, subulate apex about 3 mm. long; anther about 8 mm. long shortly apiculate, dorsifixed about 3 mm. from base. Gynaeceum about 1·7 cm. long; ovary oblong wider towards top; style clavate below the trumpet-shaped 3-lobed stigma.

Mid. W. Yunnan:—Tali Range. Eastern flank. Grassy situations on the margins of pine forests. Alt. 11,000–12,000 ft. Lat. 25° 40′ N. Plant of 18–24 ins. Flowers watery white, blotched and spotted pale purple, base of perianth deep purplish-maroon, faintly fragrant. G. Forrest. No. 3845. June 1906.

Mid. W. Yunnan:—Tali Range. Eastern flank. Pasture on the margins of pine forests. Alt. 12,000–13,000 ft. Lat. 25° 40′ N. Plant of 18–30 ins. Flowers satiny white spotted crimson-maroon. G. Forrest. No. 7160. Sept. 1910.

Mid. W. Yunnan:—Tali Range. Alt. 11,000 ft. Lat. 25° 40′ N. G. Forrest. No. 11,624. Aug. 1913. Dup. of 1906–1910.

The chief points of difference between this species and *N. pardanthina* are:—a more robust and taller plant; the much longer and broader long-acuminate leaves; the white flowers with all the segments spotted purple or maroon.

This Forrestian species conforms well with the characters of Nomocharis as given first of all by Franchet. It is otherwise with a species placed in the genus by Franchet in 1898 with the name *N. meleagrina*. I have not seen *N. meleagrina*, Franch., and can only give here Franchet's account of it.

N. meleagrina, Franch. in Journ. de Bot. xii (1898), 196.[1]

"Many feet high. Leaves linear lanceolate long-acuminate, upper sparse (middle and lower wanting).

[1] Franchet's description runs:—

Nomocharis meleagrina.—Pluripedalis; folia lineari-lanceolata, longe acuminata, superiora sparsa (inferiora et media desunt); flores axillares,

Flowers axillary long-pedicellate; pedicel 15 cm. long arcuate-patent equalling or exceeding the leaves. Perianth rose with equally and densely distributed broadish red-fuscous spots on all the segments, 7–9 cm. in diameter widely open, almost plane; calycine segments quite entire ovate lanceolate acute or shortly acuminate; petaline segments scarcely broader than calycine and equalling them in length, sparingly and subtly erose above; crest of the basilar nectar-gland deep red-fuscous, fan-shaped, variously incised. Stamens one-fifth the length of perianth. Style as long as ovary; stigma globose obscurely lobed.

"N.W. Yunnan:—Mt. Sela, banks of the Mekong. R. P. Soulié. No. 1032."

By description and by Franchet's comments we can recognise that this *N. meleagrina* is markedly different from *N. pardanthina* in the much larger leaves, apparently 15 cm. long, which are not whorled in upper part of the stem; long pedicels as long as the leaves; larger flowers; perianth-segments equal in length and breadth; all the perianth-segments equally and densely spotted; faint erosion only of upper part of petaline segments: stamens only one-fifth of length of perianth. It is clearly also not the same as *N. leucantha*.

Of its characters, that which is of importance as a criticism of the generic characters founded upon *N. pardanthina* is the slight dissimilarity of the sepaline and petaline segments:—they are similarly spotted, of equal length and breadth, and the petaline segments are scarcely erose on the margin above.

longe pedunculati, pedunculis 15 cent. longi, arcuato-patentibus, folia aequantibus vel superantibus; perianthium (diam. 7–9 cent.) late apertum, fere planum, roseum cum maculis latiusculis, rubro-fuscis, in omnibus foliolis aeque ac dense distributis; foliola calycina integerrima ovato-lanceolata, acuta vel breve acuminata; foliola corollina calycinis vix latiora, illis aequilonga, superne parce et subtiliter erosa; cristae basilares intense rubro-fuscae, flabelliformes, varie incisae; stamina perianthio 5-plo breviora; stylus ovarii longitudine, stigmate obscure lobato, globoso.

Hab.—La Chine occidentale: province de Se-tchuen, sur les montagnes de Sela, sur les bords du Mekong (R. P. Soulié, n. 1032).

Diffère du *N. pardanthina* par ses feuilles plus grandes, éparses, et surtout par son perianthe dont les divisions sont égales et toutes couvertes de taches brunes, les trois intérieures à peine érodées sur les bords. Dans le *N. pardanthina*, les trois divisions intérieures sont presque arrondies, incisées-érodées dans leur moitié supérieure.

One other plant has been put in Nomocharis. Léveillé in 1913 published the name *Nomocharis Mairei.* Of this species all that Léveillé says is:—[1]

"Scarcely 2 ft. high. Separated from *N. meleagrina* by its ovate leaves verticillate excepting the lower which are opposite; white terminal flowers; clavate stigma. Distinguished from *N. pardanthina* by its broad leaves and abruptly acuminate corolline segments.

"Yunnan:—Pastures of the plateau of Ta-hai, 3200 m., fl. white spotted black (internal divisions). E. E. Maire. July 1912."

We have at Edinburgh specimens (No. 269, Herb. Edin.) obtained from Abbé Maire in 1913 bearing the same ticket, and it is without doubt the plant which Léveillé has named. Ta-hai is in N.E. Yunnan, about long. 103° 10′ and lat. 26° 55′. In addition, we have the same plant in specimens (No. 107, Herb. Edin.) obtained from Abbé Maire, also in 1913,—labelled "Pastures of the summits at Pé-long-tsin. Alt. 3200 m., fl. white. E. E. Maire. July"—from the same region. I believe I know, therefore, what Léveillé had before him.

Maire's specimens do not fit Franchet's description of *N. meleagrina.* Prominent and valid differences are the shorter leaves, not long-acuminate; the much shorter flower-pedicels, not 4 cm. long—they are 15 cm. in *N. meleagrina*; the smaller white flowers with dissimilar sepaline and petaline segments; the toothed and fringed petals.

The two characters — broader leaves and abruptly acuminate corolla segments—by which Léveillé separates *N. Mairei* from *N. pardanthina* would not alone, if they existed, suffice as specific marks. As matter of fact, the petals of *N. pardanthina* are as abruptly acuminate as are those in Maire's plant, and the difference in leaf-width seems to be hardly appreciable. Maire's plant is not *N. pardanthina,* but Léveillé has not got hold of the dis-

[1] Léveillé in Fedde Repert. XII (1913), 287.—
Nomocharis Mairei.—Vix bipedalis. A *N. meleagrina* folia ovata, inferioribus oppositis exceptis, verticillata; flores albi terminales; stigma clavatum illam plantam secernunt. A *N. pardanthina* foliis latis et foliolis corollinis abrupte acuminatis dignoscitur.
Yun-Nan: Pâturages du plateau de Ta-Hai, 3200 m., fl. blanches mouchetées de noir (divisions internes), juill. 1912 (E. E. Maire).

tinctive characters. The plant is much more like *N. leucantha*. Indeed, in flower it is somewhat of a miniature form of that species. It differs from it, however, in foliage and other points, and is probably the N.E. Yunnan representative of this Mid. West Yunnan species. The following is a description of the plant based upon Maire's specimens in the Edinburgh Herbarium:—

Nomocharis Mairei, Lévl. in Fedde Repert. xii (1913), 287 (revised character).

Stem as much as 35 cm. high with short internodes about 3 cm. long fairly stout about 4 mm. in diameter below the foliage-leaves. Foliage-leaves in whorls of 3–5 over the stem, below one or two single at the node followed by a pair, coriaceous ovate-lanceolate shortly acuminate, lower ones sometimes elliptic-ovate or ovate and obtuse, about 3·5–4 cm. long (lower ones a little shorter), 1·3 cm. broad (lower ones sometimes nearly 2 cm.). Flowers terminal solitary or in a 2-flowered raceme white with purple spots on petaline segments, rufescently blotched at base, pedicel stout ascending or erect straight to slightly deflexed tip, about equal in length to leaves. Perianth widely open almost flat as much as 5·5 cm. across; segments dissimilar more or less abruptly acuminate, tip obscurely fringed; calycine oval about 3 cm. long 1·5 cm. broad unspotted but with a small dark blotch at base, eglandular; petaline broadly ovate or rounded about 3 cm. long 2·5 cm. broad, margin from below middle toothed fringed, below entire, midrib prominent, with a bilobed basal gland, one lobe on each side of midrib, each lobe bearing a fan-shaped much incised fringed lip. Stamens about 1·2 cm. long; inflated lower part of filament about 6·5 mm. long about equalling ovary, subulate portion about 3 mm. long; anther barely 5 mm. long, dorsifixed about 1·5 mm. above base, shortly apiculate.

N.E. Yunnan:—Pastures of the plateau of Ta-hai. Alt. 3200 m. Flowers white spotted black. E. E. Maire. July. Herb. Edin. No. 269/1913.

N.E. Yunnan:—Pastures of the summits at Pé-long-tsin. Alt. 3200 m. Flowers white. E. E. Maire. July. Herb. Edin. No. 107/1913.

This plant resembles in white flowers with dark spotting *N. leucantha* rather than *N. pardanthina*, which has rose-coloured flowers. It is altogether a smaller plant than *N. leucantha*, has thicker leaves, more close-set, and without the long delicate acuminate tips we find in *N. leucantha*. The flowers, too, are much smaller. Most of the specimens show solitary terminal flowers, but one has a ripening ovary of a second flower below the terminal one.

All these plants which have been named Nomocharis are without doubt rightly placed in it. Whether specific rank can be maintained for all of them is a question that can only be answered with certainty when we know more about them. That the *N. pardanthina* and *N. leucantha* of cultivation are different species seems to me on the evidence to be unquestionable. *N. meleagrina* reads also distinct. *N. Mairei* is the doubtful species looking to *N. pardanthina* in foliage, to *N. leucantha* in flower characters. It is an outlier from the distribution of the other species. These are Mid. Western and W.N.Western Yunnan plants. It is from N.E. Yunnan, and we know that the plants of this area are, as a whole, different from, if nearly allied to, those of Western Yunnan. At the same time we are prepared in dealing with tuber-forming plants to find areas of specific distribution much wider than those of other plants. Prolonged hypogaeous life removes the plant—and the deeper the more effectively—from the influence of factors which act upon and bring about modifications in forms that have prolonged epigaeous life, and the greater constancy in conditions of life encourages greater constancy in form. The specific isolation which is so marked a phenomenon in the flora of the mountainous regions of Western China—see, for example, the genera Primula and Rhododendron—may quite well be less conspicuous in such a genus as Nomocharis, and the geographical distribution of *N. Mairei* cannot be regarded therefore as a point of much weight in relation to the question of its identity with species from farther west.

I turn now to the question of the position of Nomocharis as a genus. The leading characters of diagnosis may be stated thus:—

(*a*) Squamate bulb.
(*b*) Open perianth.
(*c*) Dissimilar sepaline and petaline perianth-segments.
(*d*) Fringed basal foveola on petaline segments only.
(*e*) Swollen lower portion of staminal filament.
(*f*) Dorsifixed anthers.
(*g*) Style.

Taken by themselves in relation to those of Lilium and Fritillaria these characters seem to be decisive as differential generic marks. But, as is well known, the limit between Lilium and Fritillaria is difficult to define—if it really exists. On the one hand, there are the Notholirions, excluded from Lilium by Baker[1] and by Elwes, but included by Bentham and Hooker;[2] on the other hand, the Liliorhizae, which have been shuttled also from one genus to the other, are now placed in Fritillaria by Bentham and Hooker[3] Into both we have yet to see much more clearly before phyletic claims are established. A recent illustration of the difficulty which botanists have experienced in assorting forms is seen in the Szechwan plant which Franchet[4] first of all named *Fritillaria lophophora*, suggesting at the same time that it might constitute under the name Lophophora a particular section of the genus. Subsequently Franchet transferred the species to Lilium as *Lilium lophophorum*[5] Now, in the light of further discoveries, it may be a question whether the place of this plant is in one of these genera, or is in Nomocharis, or in a new genus intermediate to Lilium and Fritillaria After all, so far as nomenclature is concerned, it is a matter of convenience, seeing that our genera are only temporary expressions of reaction of a phyletic line, and what we have to strive after is a grouping and naming which shall best give us a picture of phyletic relations as they appear to us.

In order to obtain data for determining the best disposal of the forms brought together under Nomocharis I will now touch in succession upon the differential characters of the genus:—

[1] Baker in Journ. Linn. Soc., xiv (1875), 268.
[2] Bentham et Hooker, Gen. Plant., iii (1883), 817.
[3] Ibid., Gen. Plant., iii (1883), 818.
[4] Franchet in Journ. de Bot., v (1891), 153.
[5] Ibid, xii (1898), 221.

The Scaly Bulb.—The elongated bulb with more or less ovate-lanceolate pointed scale-leaves of Nomocharis is very different in form from the short somewhat globose bulb with rounded tuberous scale-leaves of typical Fritillaria. It approaches somewhat the form found in Lilium, particularly that of *L. polyphyllum* as represented by Elwes.[1] It is not confined to Nomocharis outside Lilium. In 1839 Royle[2] briefly described under the name *Fritillaria oxypetala* a W. Himalayan plant which, like as it is in some features to the Fritillarias of previous descriptions, differs in certain obvious characters, and of these the bulb-form is one. The bulb if not quite the same as that of Nomocharis —there are many more and narrower shorter scales which are not so connivent at the top but more open—is yet cast on the same mould and is very different from what is found in Eufritillaria. Baker[3] recognised the difference, and taking the bulb to be more lilioid than fritillarioid, he renamed the plant *Lilium oxypetalum*, Baker. Under this name Elwes[4] figured the plant. Sir Joseph Hooker[5] brings back the plant into Fritillaria and differentiates a new species, *F. Stracheyi*, Hook. f. (W. Himalaya), with the same form of bulb. This same form of bulb we meet with also in *Fritillaria lophophora*, Franch.[6] (N.E. Yunnan and W. Szechwan), *F. flavida*, Rendle[7] (S.W. Tibet), Ward sp. No. 758[8] (S.E. Tibet), Ward sp. Nos. 741, 813[9] (S.E. Tibet). In what follows I shall use the term Oxypetala for this group of fritillaries from the N.W. and W. Himalaya, S.E. Tibet, and W. China, which in their bulb-form are like Nomocharis—so like, indeed, as to negate the value of the bulb-form as a differential character of that genus.

I must not omit to mention a character of the stem in Nomocharis which may have phyletic significance. In all the species I have seen the stem shortly above the bulb

[1] Elwes, Monogr. Lil. (1880), t. 48.
[2] Royle, Illustr. Bot. Himal., i (1839), 388.
[3] Baker in Journ. Linn. Soc., xiv (1875), 234.
[4] Elwes, Monogr. Lil. (1880), t. 5.
[5] Hook. f., Fl. Brit. Ind., vi (1892), 352.
[6] Franchet in Journ. de Bot., v (1891), 153.
[7] Rendle in Journ. of Bot., xliv (1906), 45.
[8] Probably a new species of Nomocharis of the Oxypetala series (see p. 291).
[9] Named *Nomocharis Wardii* on p. 297.

emits profusely lateral rootlets after the fashion of Lilium. I do not find this in the series Oxypetala. Does this mean that the bulb of Nomocharis lives in a shallower stratum of the soil than does Fritillaria?

The Open Perianth.—The open perianth of Nomocharis is one of its most striking features. The flower is as open as that of Meconopsis, and there may be even a slight reflexing from the base but never the recurving of Lilium. In no Fritillaria is there anything quite like it. At the same time, in the Oxypetala series we find the perianth not showing the typical campanulate form of Fritillaria. That may be a consequence of the absence of the median petaline foveola. The corolla is broadly funnel-shaped or concave, and in *F. oxypetala* is really open.[1] The character cannot be regarded as one defining Nomocharis in Franchet's sense. It appears in some other divergent forms collected by Forrest, Nos. 493, 10,620, and by Ward, No. 801, on the Burmo-Chinese frontier to fix the generic position which has led to my making this incursion into the field of Lilium and Fritillaria.

Dissimilarity of Sepaline and Petaline Segments.—In *N. pardanthina*, upon which Franchet founded Nomocharis, the contrast in form between sepals and petals is remarkable. The spotted petals are broad, nearly orbicular, with an abruptly acuminate tip, and the midrib is a relatively broad prominent ridge. The margin in about the upper half is more or less fringed, and the acuminate tip has a series of marginal outgrowths miniature of the fringe-segments of the broader part of the petal. As they lie in the expanded open flower they are cochlear imbricate and conceal the sepals save where the sepaline tips show in the corolline sinuses. The unspotted sepals, on the other hand, are ovate acute rather than acuminate, about the same length but only a little more than half as broad, and whilst they have the same reduced marginal outgrowths along their tips, want entirely the fringe of the margin of the broader portion.

The same contrast appears in *N. leucantha* and *N. Mairei*. But in *N. meleagrina* the petals and sepals are said to be all alike spotted, ovate-lanceolate, equally long and broad,

[1] See Bot. Mag. (1853), t. 4731, and Elwes, Monogr. Lil. (1880), t. 5.

and the dissimilarity is reduced to a trace of erosion of the margins of the petals in contrast with the quite entire margins of the sepals.

It would appear, then, that difference in size, shape, and spotting, between sepals and petals, is practically discarded as a generic character of Nomocharis.

In support of this we find in the Oxypetala series fluctuations in respect of these characters, and whilst all of them have upon the pointed tips of all the perianth-segments the reduced marginal outgrowths mentioned above as appearing in Nomocharis, in one,—*F. lophophora*—as Franchet himself points out, the base of the petaline segments is always minutely fringed.

Fringed Basal Foveola on Petaline Segments.—This character is made much of by Franchet, and he says it is seen in no allied genus. It requires therefore particular investigation.

The dice-box form of perianth that gives the name to Fritillaria is in great measure a consequence of the development in the middle line of each perianth-segment of a glandular area, long or short, forming a shallow pit or a deeper pit (foveola) with its long axis coincident with that of the segments. It occurs higher up or lower down on the segments, always below its middle, and gives a bulge outwards to the segments at the point where it occurs, its tissue being firmer, more fleshy, and usually darker coloured than the adjacent matrix of the segment. The surface of this area is coated with short projections—the excreting agents. This glandular area occurs on every perianth-segment. In the section Rhinopetalum of Fritillaria the bulge it forms is emphasised, and I take it gave origin to the sectional name. In the section Petilium—in so many features different from Eufritillaria—the form of the gland is nearly circular and it is basal but its position central on the perianth-segments. Now in Nomocharis the construction is different:—

(*a*) The sepaline segments have no glandular area. That is restricted to the three petaline segments.

(*b*) The glandular area is not in the middle line of the segment.

(*c*) The middle line is occupied by a strong midrib pro-

jecting on the upper surface of the segment and separating distinctly a left side of its lamina from a right side of its lamina at the base.

(*d*) The glandular area is at the base of the segment, and owing to the projection of the midrib it is divided into a left half and a right half, or, if you will, there are two glandular areas, a left-side one and a right-side one, and these are separated by the nonglandular midrib.

(*e*) Each of these dark-coloured glandular areas has arising from it a correspondingly dark-coloured flap ascending fan-ways and deeply incised, fringe-fashion, and the fringe-lobes are covered with excreting gland-cells. From dried specimens—and these are all I have been able to use for this analysis—it is not easy to be sure of minute anatomical details, and I cannot say to what extent each flap converts its glandular area into a pocket-gland, such as that which we meet with in Ranunculus; nor can I say whether the gland-area beneath the flap has excretory cells—certain is it the fringe-lobes of the flap are really glandular.

It is this spreading flap—crista basilaris—which has attracted most attention as a differential character, so far as gland-structure is concerned, in Nomocharis, but, after all, it is only a concentration of the excreting cells which in Eufritillaria are distributed more or less over the whole area. What is previous to it is the division of the glandular area into lateral halves separated by a raised midrib and the restriction of the glandular area to the petaline segments.

Were this construction peculiar to Nomocharis it might be taken as a strong generic character. But it is not so. In the whole series of Oxypetala (I except for the moment *F. flavida*, which I have not seen) we find a basal glandular area on the petaline segments only, a prominent midrib separating the glandular area into two divisions—a right and a left—the glandular area crested. In the cresting there are just such differences, so far as I can determine in dried specimens, as prevent our saying that it is that of Nomocharis. The somewhat regular fan-like expansion of a fringed flap is absent, and the cresting is distributed over the surface, extending sometimes upwards along each side of the raised midrib. But these are, if anything, details of

only specific value in themselves. Morphologically and physiologically the construction is the same. Its occurrence in the series Oxypetala detracts from its value as differential of Nomocharis. It is not a solitary character distinguishing the series Oxypetala. I have pointed out that in bulb-form also these series agree, and the individual differences of their other flower characters—none of them—negate near natural relationship. The series is markedly divergent from the type of Fritillaria. It is further away from Lilium. It touches Nomocharis at several points.

I have yet more to say about this character. The dual basal glandular area confined to the petaline segments has not always the crested form seen in Nomocharis and the Oxypetala series:—

In the Forrestian plant, No. 10,620,[1] from E.N.W. Yunnan, the gland-construction of Nomocharis is repeated with this sole difference—the flap is not fringed.

Another Forrestian plant, No. 493,[2] from the Mekong-Salween divide, shows the petaline dual basal gland separated by midrib with flaps which are not fringed and are much smaller than in Forrest's No. 10,620.

In a plant collected by Kingdon Ward in S.E. Tibet, under No. 801,[3] there is the petaline dual basal glandular area separated by midrib, but each of the areas is most minute with mere trace of flap and without fringe.

Here, then, we have three plants from W. China which have the petaline dual gland-character of Nomocharis and the Oxypetala series but without the cresting. They are not yet described. They have scaly bulbs, perianth-segments more or less equal, more or less spreading, stamens, as we shall see immediately, with slightly inflated filaments. What is their position?

Androecium.—Of all the characters of his genus Nomocharis given by Franchet that of the stamens is the most individual. The filament, which is about 12 mm. long, shows in each of the six stamens two distinct areas. A lower, some 10 mm. or so long, which is swollen into a club-shape, or one might compare it with that of a jargonelle pear. It

[1] Named *Nomocharis Forrestii* on p. 293.
[2] Named *Nomocharis saluenensis* on p. 294.
[3] Named *Nomocharis tricolor* on p. 296.

is as much as 2 mm. in diameter. From the centre of its convex summit there arises abruptly, like an elongated apiculus, a thin needle-like upper portion some 2 mm. long, which is attached by its sharp point to the connective of the anther slightly below the middle. The anther is distinctly dorsifixed. This upper portion of the filament is pale-yellow coloured, in contrast with the dark-coloured, brown or purple lower swollen portion. This lower portion gives the impression of being a hollow sac. It is not really a sac. Through the centre of it runs the vascular bundle, and it is surrounded by a cellular tissue with large intercellular spaces enclosed by some peripheral layers of more compact cells. The large anther, some 7 mm. long swinging on the top of the needle-like upper filament, perched on top of the fat lower filament, is most distinctive. It is a strong character in support of Nomocharis as a genus, for it is known nowhere else within this group of forms.

Nevertheless, we are not without approaching forms. They are to be found in the Forrestian plant No. 10,620 and the Wardian plant No. 801 previously mentioned. In them the staminal filaments are swollen in a longer, lower, dark-coloured portion, needle-like in an upper pale-coloured portion, to which the anther is dorsifixed. But the inflation of the lower portion is not nearly so great as in Nomocharis —to not quite 1 mm.—and then this lower part does not end in a convex broad top in the centre of which stands the needle-like extension, but narrows into the subulate tip. The areas from which these plants have come to us are not yet fully explored botanically, and these forms suggest that other species more closely linking with Nomocharis in this staminal character may yet be discovered.

The dorsifixed anther of Nomocharis seems to be a liliod character of little value for separating it from Fritillaria. True basifixed anthers I know of in *Fritillaria* (Petilium) *imperialis*, but in all the forms of Fritillaria I have cited here the anthers are attached by the back of the connective a short distance at least above their base and always to a finely pointed tip of the filament. It is not merely a case of intrusion of the filament between the prolonged bases of the antherine lobes. Whether in nature the anthers are really versatile, dried specimens do not suffice to determine.

Certainly in the cases of which I am speaking the anthers swing readily on the tips of the filaments after soaking in water, and the somewhat open corolla may allow of this in nature.

Style.—There is nothing distinctive in the style of Nomocharis. As in the series of Oxypetala and in those undescribed plants from West China of which I have spoken, it is clavate, usually about the same length longer or shorter than the ovary, and the apex is trumpet-shaped with the stigmatic margin more or less 3-lobed. The style of all of them is very different from the trifid style of so many of the species placed in Fritillaria.

It is clear, in the light of our increased knowledge, that the position of Nomocharis is not so isolated as the characters given by Franchet, drawn from the material at his disposal, indicate. The only character which is peculiar to all the species of Nomocharis hitherto described is that of the rounded summit to the swollen lower part of the staminal filament whence an apiculate subulate continuation proceeds. All the other characters appear, or grade into those found, in other plants described or undescribed, as I have endeavoured to show. The question we have to ask and to answer is—Can Nomocharis be maintained as a distinct genus? In my opinion it should be maintained but with an extended horizon, and I shall best make clear the grounds of this opinion if I bring together here, in what appears to me to be their natural systematic grouping, the various species, to which I have referred in preceding pages, showing relationship to Nomocharis. The species that come into consideration are:—*Fritillaria flavida, lophophora, oxypetala, Stracheyi*; undescribed, Ward sp. No. 758, Ward sp. Nos. 741, 813; *Nomocharis leucantha, Mairei, meleagrina, pardanthina*; undescribed, Forrest sp. No. 493, Forrest sp. No. 10,620, Ward sp. No. 801.

They all agree in these characters:—

Scaly bulb with elongated ovate-lanceolate or lanceolate fleshy scale-leaves. Perianth-segments always obscurely fringed at the tip. Petaline segments only possessing basal gland divided into two by prominent midrib. Anthers dorsifixed. Style clavate short about equal to ovary, trumpet-shaped at end with three-lobed stigma.

They fall into three series, to which I have given names:—

1. *Oxypetala.*—Bulb small with many narrow not connivent scale-leaves. Stem one-flowered not rooting above bulb. Foliage-leaves linear sparse. Perianth funnel-shaped or concave. Perianth-segments equal or slightly unequal, rarely petals fringed at base. Petaline glands crested all over. Staminal filaments not inflated.

   Here belong: — *Fritillaria flavida, lophophora, oxypetala, Stracheyi*; undescribed, Ward sp. No. 758, Ward sp. Nos. 741, 813.

2. *Eunomocharis.*—Bulb larger with few ovate lanceolate fleshy scale-leaves. Stem racemosely flowered rooting above bulb. Foliage-leaves oval-lanceolate or lanceolate, whorled, sparse below and sometimes above. Perianth open, often flat. Perianth-segments usually dissimilar, petals broadest, usually dentate-fringed above middle or erose. Petaline glands with fan-shaped, fringed lap. Staminal filaments pyriform, much inflated, convex at top with much shorter subulate tip springing from centre.

   Here belong:—*Nomocharis leucantha, Mairei, meleagrina, pardanthina.*

3. *Ecristata.*—Bulb larger with many fleshy lanceolate scale-leaves. Stem racemosely flowered or with 1 terminal flower, rooting above bulb. Foliage leaves lanceolate sparse or in pairs. Perianth more or less open. Perianth-segments subequal entire below tip. Petaline glands with a flap not fringed. Staminal filaments slightly inflated, tapering into much shorter subulate tip.

   Here belong:—Undescribed, Forrest sp. No. 493, Forrest sp. No. 10,620, Ward sp. No. 801.

The whole of them approach Lilium in their bulb They diverge in the petaline glands. If anyone be bold enough to combine in one genus Lilium and Fritillaria, then all these forms would also go into the new combination. But I do not see what advantage would be gained by such an aggregation, either as giving a phyletic picture or as a statement of observed facts.

From Fritillaria—to which in outward appearance the first series in particular shows great resemblance—they diverge in the bulb form, the more or less open perianth, and the petaline glands.

To refer all these forms to Fritillaria—an obvious suggestion — notwithstanding the difference, would be to ignore, I think, evident phyletic developments which have gone quite as far in a divergent direction from Fritillaria as to warrant segregation of the forms presenting them in a named genus. If we were to include them in Fritillaria they would claim the position of a subgenus. Certainly, as generic characters go in Liliaceae, the characters which

I have given above as the possession of all these plants seem to me to be adequate for the diagnosis of one, and what I am tempted to do is to use these characters as the differentiating ones of Nomocharis, taking the three series arranged above as sections of it, naming them, 1, Oxypetala; 2, Eunomocharis; 3, Ecristata. By this procedure we should emphasise the fact that we have a phyletic series that diverged from a common ancestry along with Fritillaria proper, and with that remarkable arrested branch which is conveniently placed because of lack of further evolution of its form in Fritillaria as *F. imperialis*. I have no difficulty about combining in one genus the forms of series 2 and 3 and about keeping it distinct from Fritillaria. I am more hesitant about the right treatment of series 1, for its members undoubtedly in habit—slender plants with stem not rooting above bulb, leaves long linear solitary at nodes, solitary terminal more or less drooping flower—recall strongly Fritillaria. But it would not be so natural an arrangement, it seems to me, to place series 1 in Fritillaria and to treat the other two series as Nomocharis. And so I decide to yield to temptation and to state the view that the best expression of our present knowledge of these forms of which I have been speaking is to widen the limits of Nomocharis to the extent of including them all within it, arranging them in the series with the names already given and distinguished by the characters mentioned.

The decision enables me to name the several species to which in previous pages I have referred under collector's numbers, and it requires me also to give a revised definition of the genus Nomocharis as follows:—

Nomocharis. (Revised Character.)

Perianth deciduous, more or less open; segments subequal or dissimilar, lanceolate or oval or almost orbicular more or less acuminate, obscurely fimbriate at apex elsewhere entire or variously fringed, more or less spreading; calycine eglandular; petaline with a double basal glandular area half on each side of midrib crested or fringed or not. Stamens 6 slightly adhering to base of perianth-segments or free; filaments flattened, thread-like

or swollen below and gradually or suddenly ending in a needle-like tip; anthers oblong dorsifixed, dehiscing longitudinally at the sides. Ovary sessile 3-locular, 3-angular, angles rounded; style clavate short about equalling ovary, trumpet-shaped at apex with 3-lobed marginal stigma. Bulb squamate, scales fleshy elongated, ovate-lanceolate acute or acuminate. Stem simple, leafy. Leaves alternate or whorled or both. Flowers showy, stalked, nodding, solitary terminal or distant—as many as 6—on long leafy racemes.

A genus of some thirteen species from the Himalayas and W. China.

Three sections of the genus may be recognised:—

1. *Oxypetala.*—Including *N. Wardii*, Ward sp. No. 758, and the species described under Fritillaria as *F. flavida*, *F. lophophora*, *F. oxypetala*, *F. Stracheyi.*
2. *Eunomocharis*.—Including *N. leucantha*, *N. Mairei*, *N. meleagrina*, *N. pardanthina.*
3. *Ecristata.*—Including *N. Forrestii*, *N. saluenensis*, *N. tricolor.*

The following are descriptions of new species:—

Nomocharis Forrestii, Balf. f.[1] (Sect. Ecristata.)

A tall growing glabrous plant reaching 1 m. or more. Bulb scaly elongated, scales fleshy ovate-lanceolate at first acuminate or acute, apex soon shrivelling and falling off. Stem stout about 8 mm. in diameter below foliage-leaves, rooting above the bulb. Foliage-leaves distant solitary at the nodes below the inflorescence, where they are paired, lanceolate long-acuminate as much as 7 cm. long 2 cm. broad, dark green above, glaucous beneath, conspicuously 3-veined with parallel subsidiary veins. Flowers large distant in a 6-flowered (or more) raceme with paired linear-lanceolate green leaves; pedicels stiff stout about 2 mm. in diameter horizontal deflexed at tips.

[1] *Nomocharis Forrestii*, Balf. f.—Bulbus squamatus elongatus. Caulis ad 1 m. vel ultra, supra bulbum radicans. Folia distantia, inferiora sparsa, superiora inter flores per paria verticillata, lanceolata longe acuminata ad 7 cm. longa 2 cm. lata. Flores in racemum 6-florum laxe dispositi; pedicelli horizontaliter patentes ad apicem deflexi. Perianthium late patens ad 10 cm. diam. pallide roseum nitens maculatum et basi kermesino-vasiculosum; segmenta ovalia vel ovalia-lanceolata accuminata, sub apice obscura fimbriato integra; calycina eglandulosa; petalina basi bifoveolata foveolae cujusque labio ecristato. Stamina 6 circ. 1·7 cm. longa; filamenta ovarium subaequantia, infra inflata, in apicem brevem subulatum attenuata; antherae infra medium dorsifixae.

Perianth widely open, about 10 cm. across nearly flat, satiny pale rose spotted and blotched deep crimson; segments of about the same length and width about 5 cm. long and 2·5 cm. broad more or less ovate or ovate-lanceolate, all entire and acuminate, the tip ciliate with club-shaped short white processes; sepaline segments without a basal nectar gland but always with a darker spot at the very base; petaline segments bearing a basal dark-coloured two-lobed nectariferous gland the large lobes separated by the prominent midrib, each lobe with a free rounded swollen not fringed or crested flap. Stamens about 1·7 cm. long; filaments about equal in length to ovary slightly flattened at very base, upwards dark-coloured and slightly swollen as much as 1 mm. in diameter to about 1 mm. below anther, pointed not rounded at top and passing gradually into a thin subulate paler portion attached to anther at about 2 mm. above its base; anther about 7 mm. long. Ovary about 1·2 cm. long oblong and widening upwards, about 3·5 mm. in diameter at top, 6-angled, 6-lobed at top, very finely shagreened; style slightly shorter than ovary about 1 cm. long clavate at top beneath the trumpet-shaped 3-lobed stigma.

E.N.W. Yunnan: — Mountains in the N.E. of the Yangtze bend. Open alpine pasture. Alt 13,000 ft. Lat. 27° 45′ N Plant of 2 ft. Flowers satiny pale rose, spotted and blotched deep crimson. G. Forrest. No. 10,620. July 1913.

In habit like *N. leucantha*, but a much taller plant and easily recognised by the nearly equal perianth-segments, the non-crested petaline glands, the less swollen filaments of the stamens not rounded at top of swollen portion.

Nomocharis saluenensis, Balf. f.[1] (Sect. Ecristata.)

Glabrous tall herb as much as 1 m. high. Roots thick fleshy. Bulb scaly oblong about 3 cm. long, scale-leaves

[1] *Nomocharis saluenensis*, Balf. f.—Planta ad 1 m. alta. Bulbus oblongus squamatus. Caulis crassiusculus internodis brevibus, supra bulbum radicans. Folia inferiora sparsa, superne per paria distributa lanceolata breviter acuminata, ad 7 cm. longa 2 cm. lata. Flores 3 racemosi lati; pedicelli folia aequantes, divaricati. Perianthium albido roseum maculatum patens ad 9 cm. diam.; segmenta sepalina oblongo-ovalia utrinque angustata subobtusa evariculosa eglandulosa; petalina paullo longiora et latiora subelliptica apice lata obtusa basi kermesino-

fleshy ovate-lanceolate acuminate the tip drying off. Stem stout about 6 mm. in diameter below the foliage-leaves, rooting above the bulb. Foliage-leaves solitary at the nodes below the inflorescence, truly lanceolate as much as 7 cm. long 2 cm. broad shortly acuminate, narrowed to the base and there contracted into a short and broad petiole some 5 mm. long and 4 mm. broad, conspicuously 3–5 veined with subsidiary parallel veinlets, apparently concolorous above and below. Inflorescence racemose 3-flowered, leaves on the inflorescence-axis in pairs; flowers large on a stout more or less nodding pedicel about same length as leaves. Perianth broad open approaching 9 cm. across, pale whitish rose with purplish rose spots on all segments more or less; sepaline segments oblong-oval narrowed to both ends most to the tip, narrowly obtuse ending in a conspicuous hydathodal mucro, 4·4 cm. long 2·2 cm. broad, unblotched at base, without a basal nectary; petaline segments slightly broader and shorter and overlapping the sepaline ones about 4 cm. long 2·4 cm. broad sub-elliptic narrowed to both ends broadly obtuse at apex, dark red-purple blotched at base and there provided with two cushion-like pocket-nectaries one on each side of midrib, flap of pocket not fringed nor crested. Stamens 6 about 1·4 cm. long. filaments about 1·1 cm. long flattened at the base then terete swollen dark-coloured to about 1 mm. from end, tip subulate 1 mm. long pale coloured; anther about 6 mm. long oblong thick dorsifixed about the middle. Gynaeceum about 1·2 cm. long; ovary about 7 mm. long shorter than filaments, 6-grooved the ridges between grooves rounded, 6-lobulate at summit, slightly wider at top, about 2·5 mm. in diameter; style clavate about 5 mm. long, shorter than ovary, trumpet-shaped at top with 3-lobed marginal stigmas.

N.W. Yunnan:—Mekong-Salween divide. Open moist situations. Alt. 9000–10,500 ft. Lat. 28 12′ N. Plant of 2–3 ft. Flowers pale whitish rose marked purplish rose on interior. G. Forrest. No. 493. Sept. 1904.

This is one of the plants referred to *Lilium apertum*

variculosa biglandulosa glandulae labio integro ecristato efimbriato crescentico. Stamina ad 1·4 cm. longa; filamenta ovario paullo longiora infra paullo inflata in apicem subulatum ad 1 mm. longum attenuata; antherae circ medium dorsifixae.

var. *thibeticum*, Franch. in Plantae Forrestianae.[1] It is not the same as Forrest No. 457 referred to the same variety. No. 457 is not a Nomocharis, and I do not deal with it here, for the material is hardly adequate for critical decision upon its proper place. Forrest No. 493 is certainly not *Lilium apertum*, Franch. It may be the plant Franchet referred to *L. apertum* var. *thibeticum*, which from the diagnosis Franchet gives and in the light of present knowledge I doubt being a variety of his *L. apertum*. In default of actual specimens I cannot decide. Were there certainty, Franchet's varietal name might be attached to this species of Nomocharis, but in the circumstances confusion in nomenclature may be avoided by naming it as I have done *N. saluenense*, leaving to future investigation the settlement of relation to *L. apertum* var. *thibeticum*.

The species is a distinct one in the genus. One of Monbeig's plants under No. 68/1912 in the Edinburgh Herbarium, collected near Tseku, is a Nomocharis and a near ally of *N. saluenensis*, but the material is not sufficient for certain diagnosis.

Nomocharis tricolor, Balf. f.[2] (Sect. Ecristata.)

Glabrous plant as much as 35 cm. high. Bulb scaly ovate-oblong about 3 cm. long, scales fleshy ovate-lanceolate acuminate. Stem fleshy rooting above the bulb, about 2·5 mm. in diameter below the foliage-leaves. Foliage-leaves single at the nodes below, more or less paired or in whorls of three towards the top, lanceolate shortly acuminate 4–5 cm. long about 1·2 cm. broad more or less, dark green above, paler somewhat glaucous beneath, with three conspicuous nerves and some subsidiary parallel ones. Flower large solitary terminal erect or slightly nodding; pedicel stout about 3·5 cm. long. Perianth openly concave

[1] Notes R.B.G. Edin., vii (1912), 38.

[2] *Nomocharis tricolor*, Balf. f.—Bulbus squamatus. Caulis ad 1 m. vel ultra, supra bulbum radicans. Folia sparsa superne plus minusve 2–3-verticillata, lanceolata acuminata 4–5 cm. longa, ad 1·2 cm. lata, subtus pallida subglauca Flores solitarii ad 8 cm. lati; pedicelli ad 3·5 cm. longi. Perianthium aperte concavum roseum luteo-oculatum basi rufescenti-maculatum et variculosum; segmenta subaequalia ovalia vel oblongo-ovalia acuminata apice excepta integra; calycina eglandulosa; petalina basi bifoveolata foveolae cujusque parvulae labio ecristato. Stamina ad 1·5 cm. longa; filamenta ovario sublongiora, infra inflata, in apicem brevem subulatum attenuata; antherae circ. medium dorsifixae.

as much as 8 cm. across, rose-coloured with a broad yellow eye, spotted and blotched at base dark purple-red; segments subequal outer a little longer about 4 cm. long almost 2 cm. broad oval or oblong-oval shortly acuminate, tip obscurely fringed otherwise margin quite entire; sepaline segments eglandular; petaline segments bifoveolate at base, foveola on each side of midrib small with a short convex not crested flap. Stamens 6 about 1·5 cm. long; filaments about 1·2 cm. long a little longer than ovary from a slightly flattened base upwards dark-coloured, swollen to nearly 1 mm. in diameter through about 9 mm., then tapered through about 3 mm. as a needle-like thread; anther about 6·5 mm. long dorsifixed about the middle. Ovary about 9 mm. long oblong slightly wider at top; style about same length as ovary, clavate.

S.E. Tibet. Ka-gwr-pw. Alpine meadow. 14,000 ft. F. Kingdon Ward. No. 801. 19.7.13.

A very distinct species. Easily recognised by the tricoloured flower.

Nomocharis Wardii, Balf. f.[1] (Sect. Oxypetala.)

Glabrous low herb some 12 cm. high. Roots thick fleshy. Bulb scaly slender oblong elongated as much as 3 cm. long 1 cm. in diam., outermost scale-leaves at flowering time mucilaginously rotting, within scales of the year straw-coloured few 5–6 open fleshy linear-lanceolate acuminate apex soon withering. Stem short about 3 cm. above ground thin with short internodes and bearing at most about 8 alternate ascending leaves. First leaves short more or less cataphyllary at and below soil surface, green foliage-leaves linear-ligulate as much as 9·5 cm. long 8 mm. broad with long attenuate hardly acute point, slightly paler below,

[1] *Nomocharis Wardii*, Balf. f.—Glabra humilis. Bulbus elongatus ad 3 cm. longus tenuis squamatus, squamis paucis (5–6), apertis carnosis anguste lanceolatis acuminatis apice mox marcescente. Caulis epigaeus brevis ad 3 cm. longus. Folia basalia 1–2 squamosa, superiora circ. 8 alterna lineari-ligulata ad 9·5 cm. longa 8 mm. lata subtus pallidiora. Flores solitarii ad 9 cm. lati; pedicelli ad 8 cm. longi apice cernui. Perianthium luteum emaculatum aperte concavum; segmenta fere consimilia anguste lanceolata longe acuminata margine sub apice obscure fimbriato integra; calycina eglandulosa; petalina glandula basali bipartita labio cristato instructa. Stamina ad 1·8 cm. longa; filamenta ovario longiora infra paullo inflata in apicem brevem subulatum attenuata; antherae infra medium dorsifixae.

with midrib and two lateral veins conspicuous and some subsidiary parallel nerves. Flower solitary terminal with a long stout brown glossy pedicel as much as 8 cm. long 1·5 mm. in diameter, straight erect to nodding swollen apex. Perianth openly concave about 9 cm. across yellow unspotted blotched at the base; segments similar in form narrowly ovate-lanceolate tapering to a long acuminate point which is obscurely fimbriate; calycine about 4 cm. long 1 cm. broad, basal blotch small, eglandular; petaline about 3·7 cm. long 1·2 cm. broad with a 2-lobed basal gland half on each side of prominent midrib, each lobe yellow-fringed the fringe or crest running upwards for a very short way along the midrib. Stamens 6 about 1·8 cm. long; filaments about 1·2 cm. long longer than ovary slightly flattened at very base, slightly swollen upwards to about 1 mm from top then attenuate in a subulate tip; anther about 9 mm. long shortly apiculate dorsifixed about 3 mm. from base. Gynaeceum about 2 cm. long: ovary oblong pyriform 6-angled, angles rounded faintly 6-tubercled at summit; style about 1 2 cm. long clavate beneath the trumpet-shaped end with marginal 3-lobed stigma

S.E. Tibet:—Doker La Open grassland. Shrub and forest belt. Alt. 13,000–14,000 ft. F. Kingdon Ward. No. 741. July 1913.

S.E. Tibet:—Ka-gwr-pw. Alpine meadow turf. Alt. 15,000 ft. F. Kingdon Ward. No. 813. 19.7.13.

A beautiful species not yet in cultivation. Its nearest ally is the plant described by Franchet as *Fritillaria lophophora*,[1] afterwards renamed by him *Lilium lophophorum*.[2] Ward's plant can be recognised by its grass-like foliage and the many more leaves which each stem bears. I do not find on the petaline segments of *N. Wardii* any marginal fimbriation at the base such as characterises Franchet's species, and is perhaps more constant than Franchet supposed to be the case.

This *F. lophophora* of Franchet has particular interest in relation to the question of the limits of the genus Nomocharis which we have been considering. When he described

[1] Franchet in Journ. de Bot., v (1891), 153; Oliv. in Hook. Ic. Pl., xxiii (1894), t. 2219.
[2] Franchet in Journ. de Bot., xii (1898), 221.

the species Franchet recognised the likeness to Nomocharis in the form of bulb and the crested petaline glands. At that date *N. meleagrina*, with its almost similar perianth-segments, was unknown, and Franchet naturally laid stress upon the dimorphous perianth as a mark separating Nomocharis from his new species. Now we know the character fails in generic diagnosis, and the stamens subulate from the base in *F. lophophora* are alone left of the points of difference named by Franchet to distinguish it from Nomocharis. Here, now, in *Nomocharis Wardii* we have an approach to the abolition of this staminal distinction. The filaments are inflated, though not to the extent of those in the first described species of Nomocharis, and in consequence of this less inflation the subulate top of the filament appears as a gradual attenuation of the swollen portion—does not sit like an apiculus on its summit. Whilst treating *F. lophophora* as a Fritillaria, Franchet did not do so without qualification. He recognised those characters of the bulb and the petaline glands, to which I have drawn attention, as alien to Fritillaria, and he proposed to constitute under the name of Lophophora a new section of Fritillaria, to be characterised thus:—"Bulb squamate: perianth-segments not dissimilar, traversed at the claw by crested fimbriate lamellae: staminal filaments subulate; style undivided." These characters are found, as I have shown also in *F. oxypetala*, *F. Stracheyi*, and I believe also in *F. flavida*. They are the essential characters of my section Oxypetala of Nomocharis. Franchet has preferred to use the characters for a distinct section of Fritillaria. I have preferred to widen the scope of Nomocharis and make a section in that genus—and because

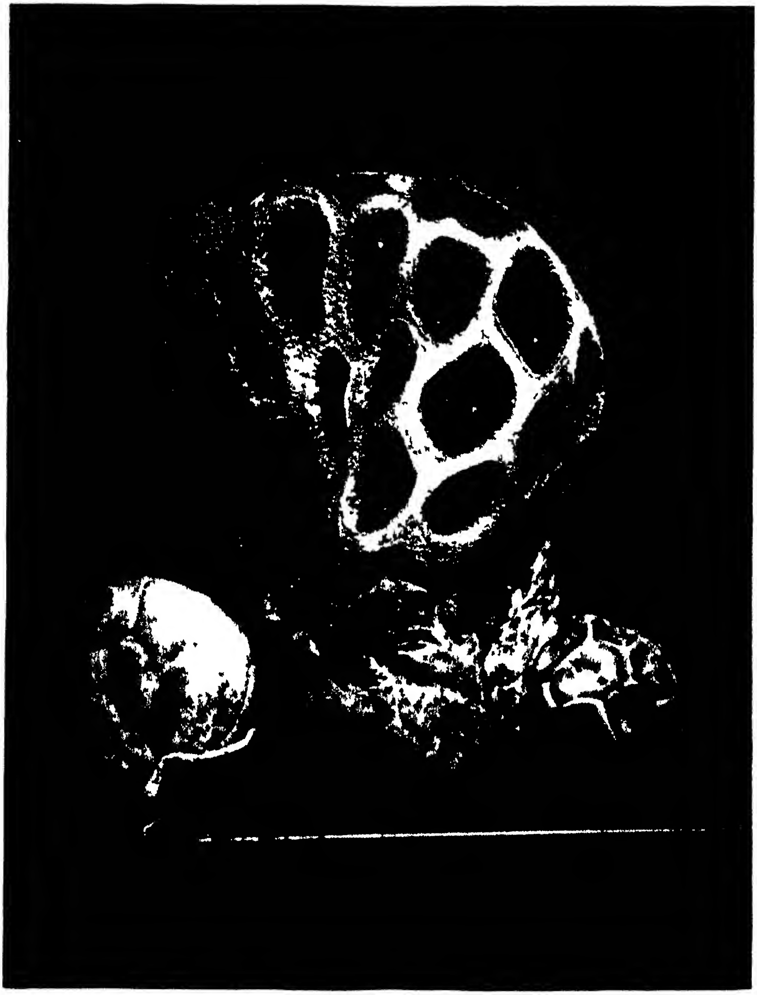
(*a*) the bulb and the petaline glands are not fritillarioid but are nomocharoid:

(*b*) the obstacle of the nomocharoid staminal filaments is broken down by the almost transition in *N. Wardii* and the Ecristata section of Nomocharis.

There is a middle course—to make a new genus for these Lophophoras and Oxypetalas intermediate to Fritillaria and Nomocharis. That may come when we know more of this group of plants, which appears to have attained

to some considerable development in Western China—and be it noted alongside of a similar development of true Fritillaria with the globose bulb formed of rounded, somewhat separate scale-leaves, and with the campanulate perianth of segments all bearing a larger or smaller median nectary—*F. cirrhosa*, *F. decussata*, *F. Delavayi* are illustrations. We may count upon more of both groups being discovered, showing perhaps other modifications into which the type has passed. Meanwhile, as I had to name the plants collected by George Forrest and by Kingdon Ward, I have endeavoured to sift the relationship of forms as we know them.

In 1898 Franchet translated *Fritillaria lophophora* into *Lilium lophophorum*, because "it has so much in common with *Lilium oxypetalum*, Baker, and *L. apertum*, Franch., that it is impossible to place it in a different genus. The bulb, the form of perianth, the dorsifixed versatile anthers are more characters of Lilium than of Fritillaria—a genus which cannot be precisely defined at the present time unless one restricts it to species with a campanulate corolla of the type of that in *F. Meleagris*, and especially to those in which the style is trifid." I agree with Franchet, except that his argument leads me not to Lilium but to a new genus or to Nomocharis, qualifying this statement, however, by saying that I have not had opportunity of examining *Lilium apertum*, which I take to be a plant not unlike *L. oxypetalum*, Baker, seeing that Franchet had previously thought it was this species.



Clathrus cancellatus, Tourn.

DAVID PAUL.

NOTES ON THE OCCURRENCE OF CLATHRUS CANCELLATUS, Tournf., IN ARGYLLSHIRE. By Very Rev. DAVID PAUL, D.D., LL.D. (With Plate No. VI.)

(Read 13th December 1917.)

This fungus was found by me on 10th September 1917 near Kilmelford, Argyll, growing in a flower border extending along the wall of a shooting-lodge. There were about six specimens, mostly in the "egg" stage. One that had burst the skin of the "egg" developed well later, and was photographed. Other two were also brought home, and grew to maturity.

It appears that this fungus has not been found before in Scotland In England it is rare, and confined to the extreme south. It has been found in the Isle of Wight, Torquay, Lyme Regis, Haslemere, Bournemouth, and near Windsor. It has never been gathered by the British Mycological Society in any of their forays It is said to have been found in the south of Ireland.

Beyond Britain the plant occurs frequently in the south and west of France, but not apparently north of the latitude of Paris. It is found also in Italy and Southern Europe in general, also in the Mediterranean islands and in North Africa. It is said also to have occurred near Brussels and between Haarlem and Amsterdam. Krombholz does not appear to have found it in Bohemia.

Clathrus cancellatus is a fungus of the order *Phalloidei*, of which *Phallus impudicus* is among us the best-known representative. It is a very conspicuous and beautiful plant At first it is enclosed in a volva, with a raised pentagonal network, and a long, white slender root When the volva bursts, the hymenium inside expands, and rises in the form of a circular or ovoid hollow sphere to a height of about four inches. This sphere is perforated in lattice- or trellis-fashion (hence the specific name), and the exterior colouring is a fine pinkish-red. The interior of the anastomosing branches is covered with an olive-brown mucus in which the spores are embedded, as in *Phallus*. The odour is extremely disgusting, so that the plant cannot be brought into a room, but this odour disappears in drying.

How this fungus, which seems to require warmer conditions than are to be found in Britain, appeared in Argyll I cannot explain. Spores may have been brought north among the roots of some imported plant, but I did not notice any such growing in the neighbourhood. It appeared to me that the occurrence of this rare fungus in Scotland was worthy of being noted by the Botanical Society.

I may add that I found at Kilmelford this autumn a good many specimens of *Clavaria aurea*, Schaeff., and of *Clavaria botrytis*, P.—both rare in Britain.

A NEW GRASS, KOELERIA ADVENA, Stapf.

By JAMES FRASER.

For the name of a new grass belonging to the genus *Koeleria*, and for its description by Dr. Stapf, I am indebted to the Director of the Royal Botanic Gardens at Kew

This grass I found in July 1916, in the neighbourhood of Edinburgh, growing among surroundings and under conditions which indicate that its seeds must have been introduced into this country along with esparto grass, from the east of Spain or the north-west of Africa.

Two or three specimens have been retained at the Kew herbarium.

Dr. Stapf's description is as follows:—

Koeleria advena, Stapf (sp. nov.)

Affinis *K. scabriusculae*, Hack., sed valvis obtusiusculis vel minute emarginatis (haud acuminatis biaristulatis) muticis vel sub apice mucronulatis valvam aequantibus (haud ea conspicue longioribus) distincta.

Gramen gracile annuum. Culmi fasciculati, erecti vel geniculato-ascendentes, graciles, 10–35 cm. alti, glabri vel internodiis inferioribus apicem versus minute puberulis, 2–5-nodi, nodo summo multo infra medium sito. Foliorum vaginae arctae, tenues tenuiter pubescentes vel summa subglabra, praeter infimas internodio breviores; ligulae breves, membranaceae, rotundatae; laminae patentes anguste lineares, superne attenuatae, acutae, 8–30 mm. longae, 1–1·5 mm. latae, molles, pubescentes, ad margines

scabriusculae vel basin versus etiam ciliatae. Panicula angusta, contracta, ambitu sublinearis, inferne interrupta vel lobata, 3–5 cm. longa, 6–10 mm. diam., ramis ramulis pedicellis glabris laevibus vel superne scabriusculis; pedicelli perbreves, rare 2 mm. longi. Spiculae ambitu obovatae, 4–5 cm. longae, superne 2–3 mm. latae, 3–4 florae, glabrae nitidulae. Glumae aequilongae, spiculam subaequantes a latere visa oblongae, obtusiusculae, 3-nerves, pallidae magis minusve purpureo-suffusae. Rachilla internodiis minute pilosulis circiter 1 mm. longis. Anthoecia 3 mm. longa, sursum per paulo minora, summum ad squamulas minutas reductum. Valva a latere visa anguste oblonga, obtusiuscula vel minute emarginata, saepe sub apice tenuiter mucronulata, in dorso tenuissime scaberula, tenuiter 3-nervis. Valvula valvam aequans, 2-dentata, hyalina, albo-nitens. Antherae 2 mm. longae.

TRANSACTIONS

OF THE

BOTANICAL SOCIETY OF EDINBURGH.

SESSION LXXXIII.

Calamagrostis stricta and C. strigosa

By A. Bennett, A.L.S.

(Read 2nd October 1918.)

C. stricta, Timm (sub *Arundo*), in Roth. n. Beit., i, 118 (1782). I use the above name and reference for the present as the name and author are not finally settled.

The first record of *stricta* was in Eng. Bot., t. 2160 (1810), from "a marsh called the White Mire a mile from Forfar, June 1807." It became extinct here about 1813 through the marsh being drained for its marl. In 1836 it was found by Dr. Moore in Ireland; in 1846 by the Rev. G. E. Smith at Delemere in Cheshire; in 1887 I recorded it from Yorkshire in the Naturalist, p. 201. In 1914 it was sent me from Hockham and Stow Bedon in Norfolk by Mr. Robinson. In Caithness it was found about 1866 by Robert Dick [1] of Thurso.

The following varieties are now on record for the British Isles.

1. var. *Hookeri*, Syme, Eng. Bot., ed. 3, xi, 56 (1872). Armagh, Tyrone, Derry, and Antrim, Ireland. Stow Bedon!, Norfolk.

2. var. *borealis* (Laest., sub *Arundo*). Killin, Mid. Perth. Mr. Druce, 1888!, and Mr. Burdon 1917!. Described by Laestadius in Bid. till Kann. Tornea Lappmark, p. 44 (1864).

[1] Smiles' Life of R. Dick, 340 (1878).

3. var. *angustata*, Wahlenb. (sub *Arundo*), Fl. Lapponica, 28 (1812). Margin of Loch Watten, Caithness, G. Lillie sp.

4. var. *pallida*, Ruprecht, Hist. Fl. Petrop., 35 (1845). Hockham, Norfolk. Mr. Robinson, 1914 !.

Hooker, Brit. Fl., ed. 1, 32 (1830), gives another station, "Rescobie, four miles from Forfar. T. Drummond," and this is repeated by Hooker and Arnott in 1860, but I can find no specimens extant from there.

Ascherson and Graebner, Flora Mitteleup. 208 (1899), have a "var. *viridis* Torges," whether this is the same as Ruprecht's *pallida* I do not know · and they have a var. *interrupta*, but later than Wahlenberg's, and they do not refer to that. It seems that our plant may not be the same as the Central European one, or perhaps as some of the Scandinavians, but the whole genus in Europe requires revision, no two authors agreeing as to the species, varieties, or hybrids. It varies greatly in the length of the glumes and the relative length of the hairs and awns. In the specimens in which the glumes are so reduced in length (3 mm.): why is it the hairs are not proportionately reduced ? But this is not the case in the Norfolk specimens, in some of which the hairs are nearly as long as the glumes ("half as long in the type") In some of the Caithness specimens the glumes are unusually long, and these have been called var *scotica* by Mr Druce, but Timm, in Mag fur Nat und Oec., Meklenburg (1795), called this *C neglecta β stricta* This name *neglecta* was used by Erhart in his Calamarioe, Dec 3, 113 (1786), and in his Beit., vi, 137 (1791), sub *Arundo*. Looking at specimens from all our recorded stations, I am inclined to think we have more than one species under it, but it requires careful collation and comparison with authentic specimens. As none of our Floras contain descriptions of the varieties, I here append them :—

2. *borealis* (as a species) Laest., in l.c

"var. A. arista subdorsali, lana corollea brevior, caulis foliata. Panicula stricta patens, foliis radicalia dilatata, aspera, stricta, elongata," a *paludosus*

"*β arenivaga*, Laest., panicula stricta patens, radix longe latique repens, folia stricta dilatata, sub exsiccatione convoluta, filiforma."

3. var. *angustata*, Wahl., l.c.
"panicula elongata lineari, floribus linearibus."
4 var. *pallida*, Rupr., l.c
panicula greenish-yellow, stiff and closed.

C. strigosa, Wahl. (sub *Arundo*), Flora Lapponica, 29 (1812), t. ii.[1]

In June and July 1885, Mr. J. Grant of Wick sent me a series of specimens from the drained site of Loch Duran. On examining them it seemed to me that some of them could not come under *C. stricta*, and were either *borealis* or *strigosa*, but having no specimens of either, I sent some to Mr. N. E. Brown of the Kew Herbarium. He replied (20.7.85), "The grass sent, after comparison and dissection, appears to be *C. strigosa*, Hartm., though the ligule is not so long or acute as in the typical plant, but I do not see what else it can be. *C. stricta*, with var. *borealis*, both have shorter glumes." In November 1885, Dr. Almquist of Stockholm wrote me, "*C. strigosa* very near the Norwegian form." In 1895, M. Husnot wrote to my late friend Mr. Beeby, "une examplaire Anglais il ne differe pas du *strigosa* recolté par Straberg en Norvege et je crois la plant anglais est bien *strigosa*." Then Dr. Druce sent specimens (but I cannot say they were the same as mine) to Dr. Hackel, our best authority on Grasses, and he named them "*C. stricta*," and said "*strigosa*" is considered a hybrid of *stricta* with *C. Epigeios*. The Swedish botanists do so consider it, but the Norwegian Blytt (ed. Dahl) Norges Flora, 77 (1906), places it as a species with *stricta*. Now the distribution of *stricta* and *Epigeios* is not altogether against this, except that *C. strigosa* is recorded from Nova Zembla and *Epigeios* is not. A few months ago I wrote to my friend Dr. Otto Nordstedt of Lund, enclosing some florets of the Caithness plant, asking him to compare them with Wahlenberg's types. These, he told me, are at Upsala and referred me to Dr. Zuel there. Dr. Zuel kindly sent me some florets from Wahlenberg's types from "Tana-elf in Finmark," in N. Lat. 70° 30′. In these I can see no sign of *Epigeios*, whose glumes are so stiff and different. Although called "elf" (*i.e.* river), it is situated about half-

[1] Trans. Edin. Bot. Soc., xvi, 313, 1886.

way down the Tanafjiord. It is curious that the label of Wahlenberg's specimens runs thus: "*Arundo hispida* Finmarkia via Tana-elf . . . 14 Juli 1802, Wahlenberg." "In herbario Wahlenbergi sub titulo *Ar. strigosa* Fl. Lapp. teste M. A. Lindblad." Dr. Zuel writes: "It is curious that Wahlenberg has written '*hispida*' on the label. I suppose that he has called the plant so at first, and then has altered the name to *strigosa* when he published his description of it." Now in *stricta* the Floras all say the ligule is short, truncate, or split, and in twenty-eight specimens, Scotch and English (not Irish or Caithness), the ligule is 2 mm. long, and truncate. In the specimens I call *strigosa* the ligule is 4 mm. long, and acute or subacute.

Scandinavia is so rich in species (15) of this genus that it is rather remarkable that Scotland is so poor. I see that Sir J. E. Smith, under *stricta* in English Flora, i, ed. 2, 170 (1828), remarks, "Hairs but half the length of the largest valve, a little elongated as the seed ripens."

C. strigosa occurs in Finmark, Russian and Swedish Lapland, W. Bothnia, Iceland, Greenland, and Nova Zembla, *C. Epigeios* in Finnish Lapland (in 68° 45′ N. Lat.), "in regione pinifera";[1] in Russian Lapland, at Kitsa, in 69 N. Lat. *C. stricta* in Russian Lapland to 68 N. Lat, and to 68° 30′ N in Finnish Lapland.[2]

In his description of *stricta* Wahlenberg says, "arista tenui sub apice inserta corollam subaequante", in *strigosa*, "arista tenui dorsali corollam aequante." Comparing florets of the Delemere, Cheshire, plant, I find under a ¼-lens the awn equals in many florets the palae. It may, however, be said the period of growth may have something to do with this In Norfolk specimens of *stricta* the awn is actually 2 mm. longer than the palae (gathered end of June). Does this not tend to show that our plants want more examination and comparison with European examples? And some of the hairs are also longer than the palae.

[1] Wainio, La flore Lapp. fin., 75 (1891).
[2] Herb. Mus. Fenn., 23 (1889).

Notes on the Flora of Caithness.

By A. Bennett, A.L.S.

(Read 2nd October 1918.)

In the Scottish Botanical Review (July 1912, 181) I noticed the species Mr. Crampton had noted as additional records in his Vegetation of Caithness considered in relation to the Geology, 1911, published by the Committee for the Survey and Study of British Vegetation; but did not allude further to it. It is, from the ecological point of view, a most excellent piece of work, and makes points not noticed before in British books, and must be well studied by the author of any future Flora of Caithness.

Along the east coast he gives some really extraordinary assemblages of plants, as at Leabana Daione opposite Ramscraigs, between Berriedale and Dunbeath in a landslip of the sandstone cliffs. He gives a list of ninety plants, with *Caltha palustris*, Linn., having leaves 6 inches across on stalks 18 inches long, *Angelica sylvestris* 6 ft. high, and *Pteris aquilina* head high and difficult to enter. There is a continuous dropping of water from above, where at Ramscraigs a height of 380 ft. is given by the O. Survey.

There are still about twenty-six species that may occur in the county, with records in counties and vice-counties ranging from 81 to 111, there being no climatal or distributional reason against their occurrence.

In the following notes I give such species that have been found or recorded since my last notes appeared.[1]

Ranunculus scoticus, Marshall.—Growing with *Saxifraga Hirculus*, Linn., at Loch Rhuard. W. G. Lillie sp.

There are some violas I meant to record here, but I have not received Dr. Drabble's names for them.

Saxifraga stellaris, Linn.—Morven. Crampton, p. 43. He remarks that this is the only place he has seen this *Saxifrage* in. Morven seems poor in alpines, while within

[1] Trans. and Proc. Bot. Soc. Edin., xxvii, 135, 1916–17.

twelve miles, on Bein Griam Mhor in Sutherland, there is found among others, *Saussurea alpina, Saxifraga oppositifolia, Silene acaulis, Lycopodium annotinum, Dryas octopetala,* and *Cornus suecica.* Mr. Crampton reports that prolonged search failed to find any of these on Morven, Maiden Pap, or any other hills or crags in the county.

Parnassia palustris, Linn., var. *condensata,* Wheldon and Travis.—Coast swamp Dunnet Links. 3.8.1915. E. S. Marshall sp. Described from specimens gathered on the Lancashire coast and figured in the Journal of Botany, li, 87 (1913).

Scabiosa succisa, Linn.—A form of this species grows near Wick. A living plant was sent me by Mr. R. Bain of Wick The root leaves are 13 cm. long (lamina, 9 cm.) × 6 cm. wide, much thinner in texture than usual, fringed with long (3 mm.) hairs, nearly glabrous above, sparingly hairy on the under surface. The usual size of the leaves is 13 cm × 3 cm , but in Killin, Perth, plants they are 35 cm. × 5 cm.

Matricaria inodora, Linn., var. *phaeocephala,* Rupr — East of Reay. Marshall, Jour. Bot., 1916, 169.

Andromeda polifolia, Linn.—Mentioned by Mr Crampton as on record for Caithness, but I do not know where so recorded. In Scotland it occurs in the Inner Hebrides (V.C., 102), "Jura, 1812," Dr. Walker sp., on the west and to Perth on the east. Still it may occur, as it reaches Nordland in Sweden, appears in North and South Norway. and in Finnish Lapland to 68° 22′ N. Lat. Mr. Watson, Cyb. Brit., ii, 153 (1849), observes: "The distribution of this little shrub is peculiar in Britain, whether compared with that of other species which are assigned to the Scottish type, or with its distribution on the Continent of Europe It differs from the usual character of the Scottish or boreal type by its early northern limit."

Bartsia Odontites, Huds., var. *litoralis,* Reich.—By roadside pond, four miles W. of Thurso. E. S. Marshall sp. By a pond at Lower Dounreay on the coast east of Reay. E. S. M. sp.

Euphrasia borealis, Town.—Roadside, four miles W. of Thurso E. S. Marshall sp

Euphrasia curta, Wett.—Coast rocks, just above high water, E. of Reay. E. S. Marshall sp.

Utricularia vulgaris, Linn.—Waterston Loch, E. coast. G. Lillie sp. A second locality for the county.

Rhinanthus borealis, Druce.—Near Thurso J. Grant sp. Sea cliffs, Freswick. J. Grant sp.

Atriplex laciniata, Linn.—Mr. G. Lillie has sent me specimens of the above plant, larger than any southern specimens I have seen, from the coast. It was growing with *A. Babingtonii*, Woods, and *A. prostata*, Bouch.—the latter specimen agrees with others so named by the late Herr Freyn. The seed leaves of *laciniata* are larger than those of other species of the genus, and first leaves are in the north (E Sutherland) semi-rotund and nearly entire. It occurs in the O. Hebrides ', W. Sutherland, and the Shetlands, but is not quite certain for the Orkneys, though Mr. Spence sent me a very young plant that is probably it An additional record for the county.

Orchis ericetorum, Linton.—Stroma Isle Miss Geldart sp.

Orchis Fuchsii, Druce.—Caithness. Report of Bot. Ex. Club for 1914 (1915).

Sparganium ?.—Halkirk. 8.1886. Dr. A. Davidson sp. Suggested by Dr. Rothert in 1911 to be a hybrid between *S. affine* and *S. minimum*.

Juncus supinus, var. *nigritellus*, Schultz t. Buchenau.—Near Wick. J. Grant sp.

× *Salix ludificans*, F. B. White (*S. aurita* × *phylicifolia*).—"Caithness. Grant ex Bennett." White.

Carex incurva, Lightf., var. *erecta*, Lange.—Among rocks just above high-water mark, east of Reay. E. S. Marshall sp.

Carex disticha, Huds.—Marshes east of Reay. E. S. Marshall sp.

C. extensa, Good., var. *pumila*, And —Shore, east of Reay. E. S. Marshall.

C. Oederi, Retz —Coast rocks, east of Reay. E. S. Marshall sp.

C. limosa, Linn.—Yarehouse Loch. Crampton.

C. curta, Good.—Fairly common in the wet flashes of the moorland. Crampton.

Arrhenatherum elatius, M. et K., var. *bulbosum*, Presl. —Near Reay. E. S. Marshall sp.

A. precatorium, Dietrich —Lower Dounreay. Marshall, Jour. Bot., 169 (1916).

Catabrosa aquatica, Beauv., var.—Wet sand, Dunnet Bay. E. S. Marshall sp. "Annual prostrate, etc." I can find no record of an annual form of this species.

Chara hispida, Linn.—Pond, east of Reay. E. S. Marshall, Jour. of Bot., 169 (1916)

Notwithstanding Mr. Crampton had access to all parts of the county, being on the Geological Survey, he missed Mr. Lillie's records of *Saxifraga Hirculus*, Linn and *Atriplex laciniata*, Linn.

The latter name is the one used in the last edition of the London Catalogue, but it certainly is a bad name as the leaves are never *laciniate*, but Dumortier's name *A. farinosa* (1827) is preoccupied by that of Forskill (1775), and Woods' name of *arenaria* by that of Nuttall (1818). Even with the account in the Cambridge Flora of the genus, I think our plants are by no means settled.

Potamogeton longifolius, Gay, in England.

By Arthur Bennett, A.L.S.

(Read 4th December 1918.)

Potamogeton longifolius, Gay, in Poir Ency. Meth., supp. iv, 535 (1816).

P. lucens, Linn., b. *longifolius*, DC. Fl. Fr., v, 311 (1815).

P. macrophyllus, Wolfg., in R. et S. Syst. N. Mant., iii, 358 (1827).

P. lucens, Linn., b. *fluitans*, Coss. et Germ., Fl. Paris, 574 (1845).

P. lucens, subsp. *macrophyllus*, Wolfg., Nyman Consp. Fl. Europe, 682 (1882).

P. lucens, subsp. *longifolius*, Magnin, Bull. Soc. bot. Fr., 440 (1896).

P. lucens, subsp. *macrophyllus*, Hags., in Neuman's Sver. Fl., 797 (1901).

Ledebour, Fl. Russ., iv, 27 (1853).

Gren. et Godr., Fl. Fr., iii, 315 (1855).

Mühlein et Kupfer, Korresp. d. Nat. Ver. Riga, 46, 161 (1906).

Richter (Pl. Europe, i, 14, 1890) following Ledebour, *l.c.*, refers *P. salicifolius*, Wolfg., *l.c.*, and *P. lanceolatus*, Eichw., Nat. Skizze Lith., 126, 1830, to *longifolius*, but I think this is not correct.

The first description is that of De Candolle, who remarks: "M. Guersent a trouvé cette variété dans la rivière de Bapaume; elle est remarquable pour la longueur extraordinaire de ses feuilles, elles ont jusqu'à un pied de longueur sur 8–9 lignes de largeur, et se terminent en pointe allongée pas les deux extrémités." That of M. Gay is: "P. foliis oblongo-lanceolatis, utrinque acutis, subsessilis, pedunculis, longitudine foliosus: spica longa, tereti." Distribution: France!, Lithuania!, Baltic provinces of Russia, Asia, Sherard. herbarium at Oxford!, Africa! Those so named from Sweden by Dr Tiselius are rather a long-leaved form of *lucens*. The same occurs in Orkney (Johnston!). The Swiss record is also an error, teste Dr. Schroter. The specimens so named from Siberia (Herb. petrop.) are the same as Tiselius', and would come under his name of *f. insigne*. The Grand Junction Canal at Market Harboro', Leicestershire, Mr. Geo. Chester, 1916.

The leaves in the British specimens are 2–3 dm. long × 2 cm. wide (the Lithuanian specimens vary from 1·50–3·20 dm. × 2 cm.). Leaves darker in colour than *lucens*, and almost throughout their length parallel-sided. The colour is darkest in Wolfgang's specimens, lightest in Besser's, while those of Gorski come between. In the Vienna herbarium Wolfgang has a specimen "*P. macrophyllus* mihi Tab. 16." This refers to a MS. Monograph of the genus in the Library of the Moscow Soc. Imp. Naturalists. He also with Besser published many dried specimens of the genus. In *P. longifolius* we have a plant that has gradually descended from a species to a sub-var. in Das Pflanzenreich (1907) by Graebner, but in 1913 the same author makes it a variety, quoting Cham. et Schlecht. in Linn., ii, 198 (1827), but they merely say "*f. longifolia.*" Dr. Hagström (in litt.) places much reliance on the serra-

tion or non-serration of the leaves in the *lucens* group; but in *decipiens*, Nolte (by this method made into two hybrids by Graebner, *l.c.*), the serration is not constant, due in some cases to age: in others the early leaves are not so, later ones are so, as I have proved by testing dozens of specimens under the microscope. With these specimens Mr. Chester sent others that seem to me to be a hybrid with *perfoliatus*, Linn.

With regard to Wolfgang's description of the leaves, "margine crispatis," this is not shown on his specimens, but perhaps is only apparent when living. Then the stipules, "stipulis magnis, elongatis, obtusicaulis," in the majority of specimens this holds good, but in one of Besser's the upper ones are decidedly acute. In the Vienna herbarium there is a specimen from "Oregon, U.S.A., Lyall, 1861, Boundary Commission." This in 1892 I referred to Gay's plant, but now I would not be sure; it may not be the elongated form of *lucens* but perhaps the *f. insigne*, Tiselius. The *P. longifolius*, Gay of Babington, Eng. Botany, supp. t. 2847 (1840), is not the plant of Gay, but I believe a hybrid. I have named it in Jour. Bot., xxxii, 204 (1894), *P. Babingtonii* = *P. lucens* × *praelongus*. It is usually stated that only one specimen was gathered in Lough Corrib in 1835 by Mr. J. Ball; this is not so. Two were gathered, one sent in the fresh state to Professor Babington, and one retained by Mr. Ball. Its history may be summarised as under: Babington in 1840 considered it Gay's plant; Hooker and Arnott in 1860 was undecided where to refer it; Syme in Eng. Botany thought at first it might be *praelongus*; Hooker's Students' Flora, ed. 3 (1884), rather contradicts itself; Fryer in 1890 placed it under *decipiens*, Nolte, but does not notice it in Potamogetons of the British Isles; and the Messrs. Groves in the 9th edition of Babington's Manual retain the account of the 8th edition and add Fryer's and Bennett's opinions.

Notes on Dr. Hagström's "Critical Researches on Potamogeton, 1916." By Arthur Bennett, A.L.S.

(Read 4th December 1918.)

Dr. Hagström's material was mainly restricted to the Scandinavian herbaria, with a few from St. Petersburg and Berlin; hence the distribution of the extra-European species is very meagre. To obviate this I sent him full particulars of all the species he has treated of, relating to their distribution. Still, it shows their herbaria are rich in the genus. It is to be regretted he could not consult our herbaria, nor those in Paris, Munich, and Vienna, nor Boissier's and De Candolle's, though he had my papers on those herbaria. In this work the author has contributed a large amount of original work. He relies greatly on anatomical characters—too much, it seems, when one tries to verify his facts by the aid of specimens grown for years. My late friend, Mr. Fryer, for many years tested the plants by growing them in tubs and in a pond in his garden, and his work shows that too much reliance cannot be placed on Dr Hagstrom's conclusions; in fact, as in all systematic botany, all and every aid is needed that can be brought to bear before we can safely say, "This is that, and that is this."

The following notes are a running commentary on his work, taking it in the sequence he adopts.

Potamogeton filiformis, Pers.—As to Fries' note on Boccone's fig., Ic. descrip Sic. et Mel. Gall. It., t. 20, f. 5, 1674, named "*pusillum fluitans*," if it is not a fair one of Wolfgang's *P. fasciculatus*, what is it? Not *pusillus*, for certain. He quotes under *filiformis*, *P. maritimum*, Pohl; but Pohl places this as a synonym under his *pectinatus*, adding *P. marinus*, L., with a reference to Eng. Bot., t. 323, and Fl. Danica, t. 186, both of which are *pectinatus*, Linn., so I do not see how it can be placed as a synonym of *filiformis*, as it is by the author. I quite agree with the author in making *filiformis* a full species, equal to *pectinatus*.

P. vaginatus, Turcz. (Europe, Asia, America).—I cannot help thinking there is some error as to this species. The

author has not seen an original specimen, but he notes that Kihlman had (Medd. Soc. Fl. et Fauna Fennica, xiv, 111, 1888). I possess two from the St. Petersburg herbarium, from the author. They bear little resemblance to the Swedish specimens named by Kihlman, but I hope to send them to Dr. Hagstrom.

P. pectinatus, Linn.—I quite agree with the author in referring *P. columbinus*, Suksdorf (Deut. Bot. Monatss., xix, 92, 1901) to this, which Mr. H. St. John also does in Rhodora, 124, 1916. It may here be noted that the author uses "turios" for the winter-buds or gemmæ, but he also applies this name to the resting-buds on the roots; but the structure of these is quite different, though they admittedly answer the same end. He divides *pectinatus* into five varieties and twenty-one forms, placing *P. striatus*, Ruiz et Pavon, under three of them. The var. *mongolicus*, Ar Benn., he thinks may prove a new species, but I do not consider the material is sufficient to so decide. He places *P. latifolius* (Robbins), Morong, under *P. zosteraceus*, Fries, but Robbins, in Bot. 40th Par., 338 (1871), distinctly disclaims this, and it is a distinct species and very rare. The "New Jersey" station given by Graebner, Das Pflanz., Heft 31, 128, 1907, is an error. The only other stations known, besides the two given by Morong, are "Huachina Mts., Arizona, 1882, G. Lemmon and wife," "King's River, Lasson Co., California, Watson," Bot. Calif., ii, 1880, and Mono Co., 1898, No. 9915, J. W. Congdon.

P. Robbinsii, Oakes (America).—One of the most distinct species in the genus, and with *P. Maackianus*, Ar. Benn., unique in structure.

P. Maackianus, Ar. Benn. (Asiatic).—The author remarks on Dr. Graebner's (*l.c.*) putting this species near *obtusifolius*, and says it is an error; but I can explain this. Dr. Graebner drew *Maackianus* and named it *ochreatus*, Raoul (a near ally of *obtusifolius*). Fortunately I saw this in the proof and corrected it, but Dr. Graebner neglected to revise the reference, although I pointed out to him that there was this error.

P. ochreatus, Raoul (Australia and New Zealand).—Dr Hagström makes a "new species (vel subspecies *P. ochreati*?) *P. furcata*, Hagst." I can well understand his

position here; for *ochreatus* he had access to New Zealand and Tasmanian specimens only. Most of these are unbranched. They are much "stretched," *i.e.* the internodes are long, as much as 18 cm. long, with very few branches if any (1–2), while in N.S. Wales specimens they are only 3–6 cm. long, and branched at every node with stout branches (*i.e.* furcate). Then he says of his new species the leaves are "cuspidata"; so they are in Victorian specimens. Like all the narrow-leaved Potamogetons, this goes through a series of changes in leaf-apices from early growth to flowering state. In Raoul's specimens (lower portions especially) the leaf-apex is, as he describes it, "linearibus apice rotundatus vel truncatus," while in N.S. Wales specimens (Yarrogobilly River) the leaves of the flowering portion are subacute! I have specimens from "Australia felix," Baron v. Mueller (which he gives as one of the two stations of his new species), but it is *ochreatus* without any doubt. Again, he gives "stylus elongatus subcurvatus." This is simply a question of age in the style, not the resulting condition of ripe fruit He admits the "Anatomia, vide supra," i.e. *ochreatus.* Again, the plant varies greatly in colour, from the green of New Zealand and Tasmanian specimens to the brownish green ("fusco-viridia") of the Murray River and other specimens. A far wider divergence from Raoul's specimens is shown by one from the Murray River (Tepper leg.). This has internodes only 2 cm. long, branched at every node, leaves 6–8 cm. long by 6 mm. wide (Raoul's has them 2–3 mm. wide), stipules stronger than usual, 20 mm long, semi-translucent, and quite a brownish green. This I have called *f. latifolia.* The habit and aspect of the plant is so different that, taking the single specimen, it might well be another species, but in all essential characters it is *ochreatus*, Raoul. Dr. Hagstrom had four specimens at his disposal for his two species. I had twenty-four at mine. I see in Raoul's second description (Choix pl. Nou. Zélande, 13, 1846), he says, "Stylus v. stigma minimum, introrsum, obliquum." That disposes of the new species.

P. Ulei, Schum. (Brazils).—I do not grasp either Schuman's reference in Fl. Brazil., iii, 3, 690, 1894, or Hagstrom's. The first refers to *P. ochreatus*, Raoul. The nervation in this

is totally different to *Ulei.* The latter says, "The leaves taper more abruptly into an apex" (*i.e.* than in *P. polygonus*, C. et S.), but this is certainly not so, neither in a specimen from Brazil nor in the drawing in Graebner's Das Pflanzenreich, fig. 25, 105 (1907). I quite think, however, with Hagstrom that Graebner's drawing of the fruit is much more like *polygonus*; for this see Cham. and Schlecht. Linnaea, ii, t. 4, f. 11 (1827).

P. confervoides, Reich. (United States).—This remarkable species was named in the Vienna herbarium by Schweintz "*P. monticola*" (*i.e.* a dweller in mountains), and he remarks, "Sub hoc nomine missa desiderata species in Auctoribus Amer. sept. Purshuis, Torreiyo, Darlingtoni, Nuttalli." So the author adopts this as a division, *i.e.* "Monticoli."

P. subsibericus, Hagst. (North Asia).—The author kindly sent me a portion of this, and he is quite correct in considering it distinct from *P. sibericus*, Ar. Benn., only once gathered by the Russian Geographical Expedition.

P. foliosus, Ratin (N America).—He remarks, "I scarcely understand how to establish a real difference between the two Morongian varieties *niagarensis* and *californicus*." Yet Tuckerman made the first into a species, and lately Piper (Cont. U.S. N. Herb., xi, 637, 1906) made the second into a species, but later he wrote (April 1915) "that after all he thinks Morong may be right." The difference between the very narrow-leaved form and *californicus* is great, but is one of size and degree only. Is it possible that the Sandwich Islands station, "I. of Oahu, in Lower Pauca, A. A. Heller, No. 2387, 2555, 1895," Brit. Mus., and "I. of Ranai along the Hawpape River, A. A. Heller, 1895," is the result of the "driftwood thrown on the shores from N.W. America," mentioned by Wallace, Island Life, ed 2, 320, 1892?

P. turonifer, Hagst. (*P. foliosus* × *pusillus*).—The specimens certainly seem to decide this is the hybrid, as the spikes are quite infertile where they occur.

P. strictifolius, Ar. Benn. (United States).—The author suggests this may be *P. foliosus* × *panormitanus*. His plant may be so—I have not seen it,—but the Canadian fruiting plant is certainly not so. The specimens of the

U.S.A. plant are not from "E. Chicago Lake, Ind.," but from Wolf Lake, Hammond, Ind. Then again he suggests his hybrid plant shall bear my name of *strictifolius*, and the Canadian plant be renamed. Why? I protest against such a course; there is no reason for it. Let Dr. Hagström name his hybrid as he likes, but my plant must bear the name I have given it.

P. gemmiparus, Robbins (United States).—Referred by the author to *P. rutilus*, Wolf. × *Vaseyii*, Robb. I much wonder what American botanists will say to this combination.

P. panormitanus, Biv.—Here the author shows by an excellent piece of writing that this must be held a separate species from *pusillus*, notwithstanding the opinion of Italian botanists that it is only a synonym of *pusillus*. The following are additional localities to those given by Dr. Hagstrom: Méry-sur-Seine (Aube), France, Hariot; Valais Switzerland, Herb. Thomas. Louisiana, Durand, No. 672, U.S.A.; San Luis Potosi, Mexico, J. G. Schaffner.

P. antaicus, Hagst. (Canary Islands).—The author need not doubt this being a new species and quite separate from *P. denticulatus*, Link! Link's species is nearest to *P. trichoides*, C. et S., and *P. condylocarpus*, Tausch.

P. Berteroanus, Phill., and *P. Aschersoni*, Ar. Benn. (S. America).—No doubt these have been confused, even by Phillipi himself; but the *pusillus* section in South America needs careful working out. The specimens are mostly very poor, and without soaking out are simply puzzles.

P. orientalis, Hagst. (Asiatic).—He here solves a problem that no one attempted, though for some years I had this laid aside as a nov. sp. with drawings. Whether the Chinese and Corean specimens can be placed here is to me yet doubtful, as contrasted with the Japanese.

P. obtusifolius, M. et K.—Authors have accepted the reference of Lessing's *P. tartaricus* to this species without demur. But the author's description seems to me to place it outside, one item alone, "multinervis," being decisive, and he notes it cannot come under "Merton and Koch's species *zosterifolius* or *compressus*, L. (here evidently referring to *P. Friesii*, Rupr.) or *pusillus*, L." I am

inclined to think, from a study of his description, that it may be my *P. Henningii* (Jour. Bot., xlviii, 151, 1910), but I have been unable to find a specimen of his plant in any herbarium.

P. loculosus, Hagst. (Himalayas).—I agree with the author in referring Dr. Brandis' "No. 3333, 1864," from the Himalayas to a new species. My specimen has a few leaves only, and *obtusifolius* seemed the nearest, as he allows.

P. lacunatus, Hagst. (British N. America).—I have specimens from Salt Lake, Anticuli, Quebec, J. Macoun, which he gives as one of the stations for his nov. sp., and the references show it is the same, but there must be some error, as my specimens have five-veined leaves, and the lacunae in the centre are only a little more than is usual in *P. Friesii* Are different plants distributed? If not, why cannot it be named young *Friesii*?

P. javanicus, Haskl. (Asia, Africa, Australia)—Here I quite agree with the author in making this into four species. In fact, has he gone far enough, as he himself suggests at page 133? There are differences in Japanese, Indian, and African specimens that eventually may prove specific.

P. lateralis, Morong.—He refers this to *P. pusillus* × *Vaseyii*, Robbins, and I see no reason why such may not be upheld, though some time ago I suggested another combination.

P. quinquenervis, Hagst. (Australia).—Only one station is given for this, hence two more may be quoted. "Upper Copmanhurst, J. L. Boorman, 1909, New South Wales. A fairly common Potamogeton in the Upper Clarence in fairly shallow water." Moreton Bay, Queensland, Bailey 1882.

P. Vaseyii, Robb. (United States).—"Spike bearing on submerged part. Greenwood Lake, N.Y., 1892, T. Morong, U.S.A." In the specimens from "Hemlock Lake, N.Y., U.S.A„ 1882, Hill," Morong has mixed *Vaseyii* and *lateralis*, Morong. In three specimens I have from Dr. Robbins there is no sign of spikes from the lower branches.

P. dimorphus, Rafin., *P. Spirillus*, Tuck. (North America). —Gay, in Compt. Rend. Acad., xxxviii, 702 (1854), made a

genus of this *Spirillus*, and he has in his herbarium at Kew "*S. diversifolius*, Gay. Int., July 1850."

P. diversifolius, Rafin., var. *spicatus*, Engelmann in Geyer's "Plants of Illinois and Mississippi," Am. Jour. Science, 46 (1843). This answers the author's query as to where described.

P. pennsylvanicus, C. et S., *P. Nuttallii*, C. et S. (N. America) teste Morong.—The name I suggested ex. Rafinesque "*P. epihydrum*" must be dropped, as the author points out, as the submerged leaves are certainly not "subcordatus."

P. alpinus, Balb.—I am much disappointed that Dr. Hagström has not done for this what he has for *nitens* and *decipiens*. Not only has no one collated the various varieties, etc., but Dr. Fischer has made it more difficult by giving some of the older names a different value to what the authors did.

P. Tepperi, Ar. Benn. (Philippine Islands).—The Australian is the true plant. I had mixed others with it, not Asiatic!

P. insulanus, Hagst. (W. Indies, Porto Rico).—I agree in referring the Porto Rico specimens to a new species, and they are certainly the same as Graebner names "*P. Nuttallii*, var. *portoricensis*."

P. hindostanicus, Hagst. (India).—Schlagintweit's No 4615 from the Western Himalayas, I thought might be *P. malaianus*, Miq., but my specimen is a miserable scrap, and the Bengal one not much better, so the author may be right here.

P. fibrosus, Hagst.—I cannot think this species can be upheld. To make a new species from one specimen, and that without a collector's name or whence it came, with only "91" on the scrap of paper, is surely unsafe. Dr. Hagstrom supposes it may originate from S. Africa. If this were carried out in herbaria, ours would supply several, but I never thought of suggesting them as new species.

P. membranaceus, Hagst. (Australia).—Simply a state of my *P. australiensis*; I am not surprised. I have the same gathering as the author describes his plant from. Some were *P. Cheesmanii*, Ar. Benn., others *australiensis*. It was years before I got together a series to show this, and mainly by the aid of Mr. Maiden of Sydney.

P. montanus, Presl (Mexico, Peru).—" = *P. mexicanus*, Ar. Benn." This can hardly be. Why should Presl in Herb. Prague! name it *P. peruviana* if he had named it *montanus* before?

P. muricatus, Hagst.—The Walcha (N.S. Wales) plant is too near *sulcatus*, Ar. Benn., but others no doubt belong to it from Victoria (Australia), and specimens in the British Museum herbarium from "Mauritius, 1819, Sir James M'Grigor," evidently belong to it. This last sheet is the only one I have seen in any herbarium from Mauritius. I made a drawing of this, and the author's drawing might well have been a copy of mine The specimens, three in number, are named "*P. lucens* with floating leaves." In my MS. notes on these I have written, "If this is not *P. sulcatus*, Ar. Benn., or *P. tricarinatus*, Muell. et Benn., then it will be a new species." It is a remarkable distribution, from the Mauritius to Australia, "but some of the reptiles and insects have Australian affinities, . . . hence we find comparatively few cases in which groups of Madagascar plants have their only allies in such distant regions as America and Australia" (Wallace, Isl. Life, ed. 2, 442, 1892). Another interesting fact is that the leaves of these specimens are of what may be termed the leathery texture of the floating leaves of the Australian species. Wallace (*l.c.*) further remarks · "There is no portion of the globe that contains within itself so many and such varied features of interest connected with geographical distribution as Madagascar and the smaller islands which surround it."

P. reduncus, Hagst. (W. Australia).—The author says that I named a specimen of this *P. Drummondii*, Benth. How this came about I cannot now tell, but Herr Baagoe must have made some mistake or shifted labels. The only specimens of *Drummondii* I ever had were half the whole collection sent me by the late Baron von Mueller, and these were the only ones in Europe (except the ones at Kew from which Bentham described the species). And the plant is abundantly distinct from any other, having ulva-like submerged leaves, as noted in the Fl. Aust., vii, 171 (1878).

P. nodosus, Lamarck = *P. Americanus*, C. et. S. — A

detailed and excellent account is given of this species, though he includes under it many names of which he has not seen specimens. These are nearly all in the Berlin herbarium, whence I had them many years ago, and made drawings of them for reference.

P. fragillinus, Hagst.—I am puzzled how the author connects my *P. lucens*, var. *floridanus*, with the Guatemala plant which he names as above. I know that Dr. Morong named this *fragillinus* as *P. malaianus*, Miq. The author refers to Graebner, Das Pflanzenreich, Heft 31, 79 and 161 (1907), where no mention is made of the Guatemala plant when *floridanus* is described.

P. variifolius, Thore (France).—The author refers this to *P. natans* × *P. trichoides*. Until this is produced by cultivation I must say I cannot believe it.

× *P. Champlanii*, Ar. Benn. (United States).—In answer to the author's remarks, I say that this has submerged leaves entire! They are 11 cm long × 10 mm. wide, 7-nerved. The upper (floating) leaves are 6–8 cm. long × 11–15 mm. wide, obtuse.

P. capensis, Scheele = "*P. Schweinfurthii*, Ar. Benn."—But Scheele's name is only in the Bremen herbarium, and only noted by me, so cannot stand. If this were allowed, there are dozens in the Vienna and Berlin herbariums that might be used.

P. gramineus, L. (*P. heterophyllus*, Schreb.).—Dr. Hagstrom gives no conspectus of the varieties, only a running commentary on them. The difficulty is great, I know, and perhaps he is wise, not having seen the series in other herbaria.

P. nitens, Weber.—The fullest and best study of this species yet given.

P. Oakesianus, Robbins (United States).—"The specimens from Pine Plains, N.Y., leg. Hoysradt (hb. Stockholm), must be considered the hybrid *gramineus* × *natans*." Whatever the Stockholm specimens are, mine from the same place (*with good fruit*) are certainly *P. Oakesianus*, Robbins. Some error in labelling?

P. lucens, L.—Dr. Hagström suggests that the African and other forms placed under this species need careful revision, and I agree.

P. Chamissoi, Ar. Benn. (Mauritius, Rodrigues).—Under *P. crispus*, L., the author remarks, "*P. Chamissoi*, Ar. Benn., must be ranked under the Lucentes." I do not know what induced this remark, but I suppose Graebner's placing it next *crispus*, as I distinctly state it has nothing to do with *crispus* (Jour. Botany, xlii, 74, 1904). Yet the strange thing is that the earliest specimens from Mauritius, "Roxburgh, 1819," are named "*crispum*," and the latest, "H. H. Johnston, 1889," are also named "*crispus*." And I believe this is the plant named *crispus* in Baker's Fl. Mauritius, 392 (1877), and also the plant sent by Bory de St. Vincent to Chamisso (before 1814), but to which he put no name in Linnaea, ii (1827), 200, which he puts under *lucens* (from the "L'ile de France"). Thus there must be something that suggests *crispus* to those who have gathered but not studied the plant. The author has only seen Johnston's specimens. On present knowledge this well-marked species is confined to the three Mascarene islands. It might perhaps have been expected in Madagascar, as they have another "*Lucentes*" species between them, *i.e.* *P. vaginans*, Bojer, of which there is a type-specimen in the Vienna herbarium. To me it stands apart, just as *P. Robbinsii*, Oakes, does in North America.

P. lithuanicus, Gorski (Lithuania).—The author remarks "I have also examined specimens from Lithuania labelled '*P. salicifolius*' which have been identical (identified?) with another hybrid, *P. lithuanicus*, Gorski, but they cannot be regarded as authentic." So he places *salicifolius* under *nitens β subperfoliatus* (Hagst.), *f. praelongifolius*, Tis., and *lithuanicus* he puts under *decipiens β brevifolius*, Hagst. I have a specimen of *P. lithuanicus*, Gorski, from the author himself, and it is labelled "*P. lithuanicus*, S. B. Gorski proff., 1847, E flumine Vilia, Lithuania." It is absolutely identical with Wolfgang's *salicifolius*. In fact, it is more like Wolfgang's own specimen I have, than those in De Candolle's herbarium from Besser. In neither case do I consider them the hybrids he places them under.

P. Gaudichaudii, C. et S.—The author notes that Graebner, in Das Pflanzenreich, Heft 31, 79 (1907), remarks, "Specimena originalia desunt." This is certainly so regarding Chamisso's, but there is an original one in the herbarium

Delessart at Geneva labelled "*P. lucens*, Isles Mariannes, Gaudichaud." These islands, formerly called the Ladrone or Thieves' Islands, were also named by Magellan (1521) "Islands of Triangular Sails." The plant has been collected by an American botanist, "M'Gregor, No. 424, in 1913," in the original locality, "River Aganà, Guam." These are at Manilla, Philippine Islands, and specimens were sent me by Mr Merrill.

P. decipiens, Weber.—The author disposes of Graebner's division of this into two. The fact is, the denticulation of the leaves in this is greatly a matter of age. Some leaves are denticulate, others on the same specimen are so minutely so as hardly to show under a ¼-inch lens. The arrangement of this by measure may be useful, but it is certainly in many cases misleading. In May leaves will be under one variety, in July and August under another. Mr Fryer insisted that these plants must be studied in the spring state, and I agree. No sectional anatomy can alter facts noted when the plants were grown and gathered month by month.

P. biformis, Hagst. (Asiatic, Mongolia, Japan).—This will stand as a species, as *P. distinctus*, Ar. Benn. (Mongolia, Japan), has entire leaves and no sessile ones like those figured by the author.

P. perfoliatus, L., var. *Richardsonii*, Ar. Benn. (N. America).—This has been made into a species by Rydberg in Bull. Torrey Bot. Club, xxxii, 599 (1905). If you take the widest difference from typical *perfoliatus* (*i.e.* species with leaves 4½ inches long), no doubt it looks a very fair species; but you must ignore all the others that come between that and the eastern U.S.A. specimens, many like var. *rotundifolius*, Wallr. Dr. Hagström seems inclined to accept this as a species, while acknowledging the anatomical differences are slight. When one comes to compare specimens from all over its distributional area (based on forty-three specimens in my herbarium), it breaks down as a species. Between the extreme western U.S.A. specimens and those from the Great Lakes there is much difference in aspect, and many Japanese specimens are half way between, and others approach the American *Richardsonii*. A remark by an excellent botanist in the

United States, the Rev. E. J. Hill, in the Bot. Gazette, 260 (1881), may here be quoted under *P. perfoliatus*: "Nearly all the plants gathered in the West have the lanceolate leaf, usually shorter than in the type specimen (var. *lanceolatus*, Robbins). They gradually vary with all degrees of difference between the variety and the typical species, so that it is often hard to tell to which they should be assigned." This is in the field, not herbarium study. It was this great difference that made me hesitate to make the variety *mandshuriensis*, Ar. Benn., a species. Dr. Hagstrom seems to think it may be so, and I believe the winged fruit is not the result of drying, hence it may be considered a species.

P. bupleuroides, Fernald (United States).—This seems very near *perfoliatus* according to Dr. Hagstrom, but I have not seen specimens, and the only real difference seems the smaller fruit.

I should here like to mention a note by an ornithologist, Mr. C. B Ticehurst, in Trans. Norf. and Nor. Nat. Soc., 195 (1918). "The affinities of most, if not all, animals are to be sought in the earlier stages of development rather than in the adult", and again at p. 200· "The greatest advancement in ornithology in modern times is, I consider, the recognition of *subspecies*, or racial forms." These two remarks are exactly what my late friend Fryer always pleaded for in Potamogetons. Lastly, how rich the Scandinavian herbaria are in this genus, collectors' names, etc., appearing that ours do not possess. Why? And unqualified thanks must be given to Dr. Hagström for the excellent use he has made of them, as a result of twenty-five years' study.

We are not yet in a position to dogmatise on many points of the genus. The naming of individual examples from small areas, without collating with those already named, is a mistake. They are valuable if accepted as results of local conditions, environment, climate, etc., but they are simply steps in evolution.

Notes from Cannock Chase on Vaccinium intermedium, Ruthe. By Captain W. Balfour Gourlay, M.C., R.A.M.C.

(Read 9th October 1919.)

Vaccinium intermedium is a natural hybrid between the Bilberry, Blaeberry, or Whortleberry (*V. Myrtillus*, Linn.), and the Cowberry (*V. Vitis-Idaea*, Linn.). Previously reported as occurring in a few places in Germany[1]—Ruthe's original specimens being gathered in 1826,—it was first recognised in Great Britain in August 1886 by Professor T. G. Bonney, who found it growing on Cannock Chase, in the centre of Staffordshire, in company with Bilberry and Cowberry. The plant was described by Mr. N. E. Brown, and illustrated in the Journal of the Linnean Society, xxiv, 125, pl. iii, the paper being read on May 5, 1887.

As early as 1870[2] an unusual form of *Vaccinium* had been discovered by D. Ball, Esq., F.R.C.S., in Maer Woods, near Whitmore (N.W. Staffordshire). Specimens of the plant were minutely examined by Mr. Ball and sent, with a description, to Mr. Robert Garner. Fruiting specimens were gathered in 1871. Mr. Garner, who firmly believed the plant to be a hybrid, showed these specimens to the Linnean Society on March 7, 1872, to illustrate a paper[3] "On a Hybrid *Vaccinium* between the Bilberry (*V. Myrtillus*) and the Cowberry (*V. Vitis-Idaea*)." This paper, however, failed to convince the Society as to the hybrid nature of the plants, "the general opinion elicited by their examination being that they were a luxuriant state of *V. Vitis-Idaea*, due to situation, rather than a hybrid." However, after Mr. Brown had read his paper in 1887, he received a letter from Mr. Garner concerning the specimens from Maer Woods. These Mr. Brown

[1] *Vaccinium intermedium*, Ruthe, Flora der Mark Brandenburg und der Niederlausitz, 377, pl. 1.

[2] Hardwicke's Science Gossip (1872), 248, "A Curious British Plant," by R. Garner.

[3] Journ. of Bot. (1872), 122.

examined and identified[1] as undoubted examples of *Vaccinium intermedium.*

V. intermedium has since been reported from the following localities:—

Scorriclett Braes, near Watton, Caithness[2]
Gorge of Achorn Burn, near Dunbeath, Caithness.[3]
Coniston Old Man, Lake District, Lancashire.[4]
Lonsdale, N.E. Yorkshire.[5]

Military duties, which kept me stationed on Cannock Chase during the greater part of the year 1919, have thus given me good opportunities for observing the hybrid *Vaccinium* and noting points of interest

Cannock Chase, the ancient hunting-ground of Norman and Mercian kings, is an upland region from 300 to nearly 800 feet above sea-level, situated in the centre of Staffordshire. It consists of immense deposits of pebble and sand resting upon beds of red sandstone and conglomerate, the whole covered over by a layer of peat of variable depth. Approaching the Chase from the north, we ascend through woods of oak and birch with an undergrowth of *Pteris aquilina* and *Scilla nutans.* Ericaceous plants gradually appear as the trees become scarcer, until the open moorland is eventually reached where *Calluna, Erica, Vaccinium* and, in places, *Empetrum* are seen to be the dominant species. Locally, in certain areas, *V. Vitis-Idaea* is present in great abundance, mixed with *V. Myrtillus.* It is in such areas that *Vaccinium intermedium* occurs. The preponderance of *V. Vitis-Idaea,* usually noted, might suggest the probability of its being the male parent of the hybrid.

The hybrid, as seen on Cannock Chase, presents several interesting features. In the upper part of the Sherbrook Valley and neighbouring plateaux it is locally very abundant, occurring in patches which are often widely

[1] Postscript to article "*Vaccinium intermedium,* Ruthe, a new British Plant," by N. E. Brown, Journ. Linn. Soc., xxiv, 125.
[2] A. Bennett, Annals of Scottish Natural History (1904), 249.
[3] C. B. Crampton, The Vegetation of Caithness considered in Relation to the Geology, 1911.
[4] Bot Soc. and Exchange Club of Brit. Isles Report for 1915, 273.
[5] Ibid. for 1917, 116.

separated. Plants of *Vaccinium intermedium*, with the vegetative vigour common in hybrids, increase peripherally at the expense of the neighbouring flora, by pushing out creeping root-stocks in all directions. Thus the size of a patch of the plant bears a simple relation to its age. The various patches show considerable differences in habit, size, and shape of leaves and stem, flowering season and fertility, etc., though the plants in any one patch show a considerable degree of uniformity. This individuality, shown by the various patches, would tend to suggest that each patch owes its origin to a separate act of cross-fertilisation.

As there are many upland areas in Great Britain and Ireland where Bilberry and Cowberry grow together, it is curious that, while the hybrid is found in very few of such areas, it should be quite common in portions of one of them—to wit, Cannock Chase. As upland areas are peculiarly attractive to botanists, it can hardly be supposed that the hybrid is really comparatively common but usually overlooked. Some factor specially favouring the production or spread of the hybrid must then be present on Cannock Chase.

I first noticed the hybrid in May 1919, and showed it to Captain G. M. Vevers, R.A.M.C. (since demobilised). In the next few days we each found several other hybrid patches and compared them. Vevers pointed out that, of the seven hybrid patches then noted, six were growing in positions where some artificial and gross disturbance of the ground had occurred. Thus, in three cases, patches were found growing along the edges of trenches, the other three being found respectively: (*a*) on what looked like an old gun position, (*b*) on an area formerly used for bombing practice, and (*c*) on a pond embankment composed of layers of cut peat. The remaining site showed no obvious evidence of disturbance. The embankment appeared to be a work of much earlier date than the evidences of military training, and the hybrid patch upon it was much larger than the others. Vevers suggested that the violent crushing or shaking together of flowering plants of Bilberry and Cowberry might have resulted in their cross-fertilisation.

I have subsequently found many more patches of the

hybrid, and these have tended to confirm Vevers's observation. Thus, one afternoon and evening in August I collected specimens from thirty separate patches, noting any peculiarities of site in each case. The patches were situated as follows:—

On artificial banks of cut peat	9	24	Total 30
Along old cart tracks	7		
Along edges of drains cut on moorland or roadside	4		
On edges of trenches	1		
About bomb holes	1		
On old gun position	1		
On moorland path	1		
Where no obvious evidence of disturbance was noted		6	

Of the six latter sites, two were near mining villages where the common is well patronised, the other four being near camps, on ground long used for purposes of military training. On one roadside bank, built of peats, birches of considerable size were growing, and the hybrid had spread out from this bank over the neighbouring moorland to the extent of about a quarter of an acre. (The exact area, however, was difficult to determine owing to recent obliterating action of a moorland fire which had left here and there isolated portions only of the hybrid patch. These scattered portions may not, as at first supposed, have all been parts of the one large patch.) On a natural bank, near a hut constructed during the war, I found a single hybrid plant of two or three years' growth. An artificial bank often harbours several patches of the hybrid, while near it Bilberry and Cowberry grow intermingled, but with the hybrid absent. The places in Great Britain and Ireland where Bilberry and Cowberry grow together are usually wild and comparatively unfrequented. Though wild, Cannock Chase is much frequented.

Several groups of fruit-gathering children, on interrogation, pointed out "Bilberry" and "Bunchberry" (local name for *V. Vitis-Idaea*), but failed to distinguish the hybrid from Bilberry.

Though *Vaccinium intermedium* is thus apt to be mistaken for *V. Myrtillus* rather than for *V. Vitis-Idaea*, it resembles the latter in its evergreen leaves and almost cylindrical stem. The leaves, however, are usually less

glossy and more pointed than those of *V. Vitis-Idaea*, and, on the other hand, tougher and more deeply veined than those of *V. Myrtillus*, from which plant the hybrid can be distinguished by its subterete stem and less upright habit.

The hybrid flower is roughly intermediate in shape and colour between those of *V. Myrtillus* and *V. Vitis-Idaea*, but the anthers are provided with conspicuous dorsal awns, thus favouring *V. Myrtillus*. (The anthers of *V. Vitis-Idaea* are described in most of the text-books as "awnless." In most of the specimens that I examined in Staffordshire, small and inconspicuous dorsal awns were present. Some, however, appeared to be awnless.)

The hybrid fruit is a little smaller than that of *V. Myrtillus* or *V. Vitis-Idaea*. It is plum-violet in colour, and slightly longer than broad, but more regular in outline than that of *V. Myrtillus*. The latter often appears as if truncated about the calyx scar.

The hybrid produces little fruit, and the berries contain only a small proportion of well-developed seeds, though in this respect different patches show great variation. I have found large patches without sign of flower or fruit: and from a comparatively small patch (measuring 3 by 7 yards) I have picked over 200 ripe berries without exhausting the supply. One hundred of these berries, however, only yielded 209 apparently well-developed seeds, against more than 300 seeds for 100 berries collected from a variety of patches.

Professor Bonney found *Vaccinium intermedium* in full flower on Cannock Chase on August 29, 1886, but found only two ripe berries. I found the plant in full flower at the end of May 1919, and in full fruit in the middle of August. However, in the latter half of the month many of the patches were again in flower or in bud, including the one found flowering in May. Thus the hybrid, like *V. Myrtillus*, is wont to produce two crops (of flowers at any rate) during the season.

On August 23, 1919, I spent the greater part of the day in the Whitmore district of N.W. Staffordshire. Maer Heath and Whitmore Common are separated by a valley through which runs the main line of the L. & N.W. Railway. With the same Bunter grouping of pebble beds and sand-

stone, these uplands resemble Cannock Chase both geologically and botanically, but Maer Heath is largely planted with Scots pine. Mr. Garner, in his Science Gossip paper, tells us that this plantation is the one referred to by Darwin (Origin of Species, chap. iii), where he describes the changes in fauna and flora which had resulted from the enclosing a portion of the Heath with the introduction into the enclosed area of but one species (*Pinus sylvestris*), when a considerable increase in the number of species of insects and insectivorous birds was noted. I found four widely separated patches of the hybrid *Vaccinium* on Maer Heath, and one patch, with unusually fragrant blossoms, on Whitmore Common. The Maer Heath patches showed marked individuality of growth and habit. A small patch, growing on a dry artificial bank, showed a very striking reduction in the size of the leaves. Another patch, with large glossy leaves, though measuring only 9 yards by 16, was the largest that I found. (I was expecting to find a patch of considerable size.) Situated, however, in a dense part of the pine wood, its growth may have been retarded by shade. Growing near the edge of the wood and not far from houses, it might have been expected to attract attention. Moreover, twigs from this patch bear a marked resemblance to the figure illustrating Mr. Garner's article in Science Gossip for 1872. It is, I think, very probable that Mr. Ball collected specimens from this patch in 1870.

Some of these early specimens were sent to Charles Darwin by Mr. Garner, who referred to the plant as a hybrid. Darwin, taking also into account the shrivelled appearance of the pollen which Mr. Ball had noted, suggested that the seeds would show infertility. However, should the seeds collected this year on Cannock Chase prove to be fertile, it must be taken into consideration that the hybrid flowers may have been fertilised by the pollen of Cowberry or Bilberry.

The small hybrid patch (previously mentioned as measuring 3 by 7 yards, and giving a comparatively large yield of fruit) was a mere remnant round which a moorland fire had swept—a small green island in a sea of blackened ashes. The patch itself was an almost pure growth of the

hybrid, containing but a trace of Cowberry at one spot. Nine yards away a few small plants of Bilberry had survived. The fire took place before the plants could have set seed. The small percentage of good seed yielded by the berries from this patch (209 seeds from 100 berries, as compared with over 300 seeds from 100 berries collected[1] at random) may have been due to the comparative absence of pollen from Cowberry or Bilberry

Seeds from this patch will be sown apart from the others, and any difference in the offspring noted.

If the hybrid seeds reproduce hybrid plants, one might expect occasionally to find hybrid patches growing apart from Cowberry and Bilberry. Out of some fifty hybrid patches examined, I have only seen *two* showing isolation from the parent forms—one being the patch isolated by fire, the other being the small-leaved patch on Maer Heath, where the dryness of an artificial bank had killed out all other vegetation and had notably modified the habit of the hybrid.

It is possible that birds do not carry the hybrid seed to any great extent. I have several times noted wounds on the ripe hybrid fruit, suggesting that birds, having tasted, had gone away to seek the more appetising Bilberry. Compared with Bilberry and Cowberry, the hybrid fruit is lacking in flavour.

If the hybrid seed reproduces parental forms, it will be of interest to note the proportion of Bilberry and Cowberry among the seedlings.

[1] Had the fruit collected "at random" contained no berries from the patch in question, the difference would have been even more striking.

N.B. The berries were gently broken under water, and the seeds extracted by a rough centrifugal method, so that only comparatively heavy seeds were counted.

Scottish Records of Myelophilus (Hylurgus) minor (Hartig). By R. Stewart MacDougall, M.A., D.Sc.

(Read 6th February 1919.)

This species has been described by Fowler as "very rare in Britain." In 1915 and earlier Mr. J. M. Murray found the workings of *M. minor* on Scots Pine in Murthly Woods. In 1915 Mr. James Munro found an imago in Forfarshire. In 1915 and following years Mr Walter Ritchie found the beetle in all stages in very large numbers over an area of fifteen square miles in the Aboyne district of Aberdeenshire.

Lieut. R. Grant Broadwood, whose specimens I have verified, found the workings of *M. minor* as follows:—In Dungarthill Woods, near Dunkeld, on Scots Pine (the trees were dead), in July 1918. On the bark of blown Scots Pine (the trees were dead) on Muir of Thorn, Perthshire, in August 1918. On the bark of felled Scots Pine on Birnam Hill, Perthshire, in August 1918. On the bark of felled Scots Pine in woods round Pitlochry Hydropathic Hotel, in September 1918.

Mr. H. M. Steven writes as follows:—"During the past year I have found *Myelophilus minor* in two widely separated and different localities. The first record was obtained at Braigh Udine, Glengarry, Inverness-shire (6-inch Ordnance Survey, Sheet XCVI, Inverness-shire), in July 1918. This wood is an outpost of an old natural Scots Pine forest which stretched over this district. The trees are from 100 to 300 years old. *M. piniperda* was also present, but *M. minor* was the predominating species. The wood now forms an island in a sea of peat. About two miles away there is a planted wood containing Scots Pine, but careful search gave no trace of *M. minor* there. It would therefore seem probable that *M. minor* had bred for centuries in this old natural forest. The second record was obtained at Minkie Moss, Dupplin, Perthshire (6-inch O.S., Sheet XCVIII, Perthshire), in October 1918. *M. minor* predominated here also, and was busy at work on the dying and wind-blown Scots Pine."

The Preservation of Artificial Cultures of Moulds, By Harry F. Tagg, F.L.S.

(Read 10th April 1919.)

A culture of a mould on nutrient gelatine or agar-agar may be killed with formaline vapour, and if it then be sealed up in the Petri dish in which it grew it will keep indefinitely, provided sufficient formaline vapour is present to prevent chance infection from the outside during the sealing process. The method ceases to be satisfactory when the mould is one that causes liquefaction of the medium on which it grows, because when this is the case the Petri dish cannot be tilted from the horizontal position. With cultures that are to be exhibited in a museum it is a distinct gain to be able to display them tilted at any desired angle, and with class specimens also it is an advantage to be able to handle them freely.

In the case of species that do not liquefy the medium, the latter may be cut out of the dish with the culture attached and dried down on a square of glass or stiff card. Cultures thus dried make useful reference specimens. The method has been advocated as a simple way of preparing herbarium specimens of artificial cultures grown on agar-agar [1] It has the disadvantage where museum specimens are concerned and appearance is of importance that the surfaces of cultures tend to crack into discontiguous areas as the jelly matrix shrinks.

In the preparations now exhibited the difficulties associated with liquefaction of the medium and the areolation resulting from the contraction of the medium in the case of cultures that are dried, are alike avoided by the removal of the medium altogether. This has been done by floating the cultures on the surface of a dish of water warmed up sufficiently to cause the medium to melt. This method has given excellent results with cultures grown on gelatine, but is not so well suited to the preservation of agar cultures because of the slow solubility of the latter medium. In carrying out the method the procedure is as follows:—

[1] Hedgcock and Spaulding, Journal of Mycology, xii (1906), p. 147.

After cutting the jelly free of the edge of the Petri dish, the jelly is raised up slightly on one side by slipping under it the end of a broad section-lifter, and at the same time this side of the dish is slowly submerged in warm water. The jelly with the culture on it floats up from the bottom of the dish and the gradual total submersion of the latter leaves the culture free on the surface of the water. Any liquefied medium present diffuses at once, and the rest of the medium sinks and diffuses as it slowly melts. A square of glass of suitable size, or a piece of card if the specimen is to be preserved dry on a card, is passed below the culture and the latter is lifted carefully from the water. A certain amount of water will be taken up on the support, and this serves to permit the culture to be floated to any desired position. Absorbent paper applied to the edge of the support takes up this excess water, and the culture settles down in contact with the support and adheres to it.

If a dry preparation is wanted, all that it is necessary to do now is to allow the preparation to dry slowly in the air.

Reference collections made in this way, if mounted on glass supports of uniform size, may be stored in grooved boxes of the kind used for the storage of photographic negatives.

If the preparation is to be much handled, the surface of the culture should be protected. I adopt in this connection one or other of the following devices:—

A watch-glass sufficiently large to cover the culture is inverted over it, and is fixed in position by a thin layer of Canada balsam smeared around the edge. When this first luting has set firm the preparation is sealed up with a final luting of gold size, asphalt, or white cement. Alternatively, the culture may be protected by a plane glass disk supported on a circular wall of shellac or wax spun by means of a turntable around the outside of the culture. A cell of suitable depth is made and the glass disk luted down with gold size, the procedure being quite the same as that usually followed in mounting a microscopic object in a cell under a cover-glass.

Cultures so prepared make very good reference specimens,

but in the case of cultures intended for museum exhibition I prefer to adopt a method that secures a moist atmosphere over the cultures while at the same time the subaerial mycelium is preserved in a thin layer of glycerine which gives to the hyphal filaments a translucence that approaches closely the appearance they have in the living culture. In following out this modified method the procedure is the same as that already described, up to the point when the culture is adjusted on the support and is brought in contact with it by the withdrawal of the excess water. The support is then carefully dried round about the culture. A preserving fluid made of equal parts of formaline, glycerine, and water is placed in small drops around the edge of the culture just outside the limit of its growth. This fluid runs under the culture and penetrates the subaerial hyphæ, but does not wet the surface or alter appreciably the appearance of the aerial parts. An inverted watch-glass or a glass disk is now luted down with gold size in the manner already described for dry preparations, but it is necessary to remember when covering such preparations that the inside of the cover-glass should be coated with a thin film of glycerine so that any condensation of moisture on the under side of the cover-glass may not obscure the culture beneath it. It should also be borne in mind that luting cements, as a rule, are rendered less adhesive if the glass they are applied to bears even a very thin film of glycerine, and precautions should be taken to prevent the preserving fluid spreading from the culture to those parts of the supports to which the sealing cement will be applied.

As supports for cultures, squares of glass, for most purposes, are better than cards. They permit the back of the culture to be examined, and with a glass support one is able to use either transmitted or reflected light when examining the culture under the microscope.

Whytockia, a new Genus of Gesneraceae. By W. W. Smith, M.A. (With Pl. VII.)

(Read 13th February 1919.)

Whytockia, W. W. Sm. Genus novum Gesneracearum.

Genus *Staurantherae*, Benth. valde affine. Ab illo genere imprimis corollae ecalcaratae structura, stylo longo gracili, ovario subbiloculari recedit. Forma structuraque floris *Didymocarpum* et *Chiritam* suggerunt.

Herba parum ramosa. Folia ampla, membranacea, opposita, altero nano stipuliformi. Flores satis magni, rosei, laxe racemoso-cymosi. Calyx late campanulatus membranaceus, 5-fidus, sinubus haud plicatis, segmentis subaequalibus. Corolla tubuloso-ventricosa, tubo haud calcarato; limbus 2-labiatus, labio postico bifido; antico 3-fido. Stamina perfecta 4, inclusa, basi corollae inserta; antherae cohaerentes, loculis divergentibus confluentibus. Discus angustus annularis. Ovarium liberum, ut videtur biloculare; stylus satis longus, gracilis, stigmate bilobato, placentae undique ovuliferae. Capsula depresso-globosa vix exserta, membranacea, in speciminibus nostris irregulariter rumpenda sed fortasse obscure bivalvatim dehiscens. Semina permulta oblonga.

Whytockia chiritaeflora (Oliver), W. W. Sm. Nom. nov.

Stauranthera chiritaeflora, Oliver in Hook. Ic., Tab. 2454.

West China:—Province of Yunnan, at Mengtsz, in a dark damp glen under shady precipices; rare. Hancock. No. 51 in Herb Kew.

var. **minor**, W. W. Sm.

A typo flore multo minore divergit.

West China:—Yunnan, at Feng Chen Len, in mountain forests. Alt. 7000 ft. Flowers pink; 2 ft. high. Henry. No. 11,232 in Herb. Kew et Herb. Edin.

A full description of the typical plant is given by Oliver in Hooker's Icones under plate 2454. Oliver preferred to retain the plant under *Stauranthera*. Recent collections

Whytockia chiritaefolia (Oliver), W. W Sm., var. *minor*, W W. Sm
Type in Herb. Edin.

Photo. R. M. Adam.

W. W. SMITH.

from China tend to show that Southern and Western China is rich in *Gesneraceae*, and many of the novelties cannot be referred to the known genera of India, Burma, and Malaya. The generic name is in honour of Mr. James Whytock, President of the Botanical Society of Edinburgh, a distinguished sylviculturist and horticulturist.

OBITUARY NOTICES.

William Watson, M.D., Deputy Surgeon-General, I.M.S.

Dr William Watson, President of the Edinburgh Botanical Society for the Sessions 1897–1899, died after a long illness on 16th June 1912, aged eighty years

He was the son of William Watson, Esq., Sheriff-Substitute of Aberdeenshire from 1829 to 1866, who was one of the pioneers in connection with ragged schools and is still remembered in Aberdeen for his philanthropic work.

Dr. Watson distinguished himself during his medical studies at the University of his native city and took his degree when barely twenty-one years of age. After a course of study in Paris, he joined in 1853 the East India Company's service as assistant surgeon, and was attached to different European regiments which were stationed at Meerut, Agra, etc. In 1856 he was offered and accepted the post of civil surgeon at Mynpoorie, in the North-West Provinces.

When the Mutiny broke out in 1857 it found Dr. Watson still on duty there. The whole surrounding country in a short time was seething with rebellion, and reluctantly it was decided that all Europeans should leave Mynpoorie for Agra, where they could take refuge in the fort. The magistrate knew that, in the event of those upholding the British authority leaving, there might be a massacre of all the loyal inhabitants, determined to hold to his post, and asked for volunteers to join him. Dr. Watson at once decided to remain with the magistrate, and alone, or almost alone, they stayed at this isolated station maintaining British authority without the necessary means of support.

Their brave action seemed to so impress the mutineers that they were some time in making up their minds to close in upon them, but at last the magistrate received private information that the Residency would be attacked upon a certain date and instructions had been given that they were all to be killed. He sent secretly a message to Agra, about seventy miles away, and asked if relief could be sent them.

A small party volunteered to ride out to Mynpoorie, and arrived just in time, as the mutineers were upon the point of attacking the station. The magistrate determined to leave immediately in the darkness of night, and by morning, along with his small escort, was a long way on the road to Agra—the whole party thus escaping imminent death.

A short time after this Dr. Watson was encamped with his regiment on the ridge outside the walls of Delhi, and when the final attack was made and the gates of the city were blown in, he, along with a subaltern officer of his regiment named Ewart, was early inside its walls—the houses along each side of the streets being still full of mutineers. The palace of the Mogul Emperors having been captured, Dr. Watson and his young friend Ewart, who afterwards rose to be the head of the police in the North-West Provinces, found difficulty in getting sleeping accommodation, and for six weeks they were obliged to sleep upon the floor of the beautiful pearl mosque within the palace walls. At the end of this time they got permission to leave the palace and take possession of a house that belonged to one of the native grandees who had fled, and during the remainder of their stay in Delhi at this time Dr. Watson and Ewart lived in those luxurious quarters.

Shortly after we find Dr. Watson at Agra, and during an engagement which resulted disastrously for the British, he got his skull fractured through being struck by a fragment of an exploded shell. While in this wounded state, and in the crowd of natives being driven back, he observed something lying among the feet of the routed men. A native who knew him was passing, and, pointing to the object lying on the ground, repeated the name of an officer whom Dr. Watson knew by name. Although in a dazed

state he at once rushed to the rescue, and, as no one would stop a moment to help, he managed to get the wounded man upon his back and carried him for about half a mile until he reached a waggon, when he collapsed himself. Watson and the officer he had rescued were both taken to the hospital within the fort at Agra, and at first it was thought that Dr. Watson's wound was much more serious than that of the other man; but the officer died, and Watson survived to live a life of much usefulness.

Dr. Watson married in 1867, and, accompanied by his wife, went out to India, and from 1867 to 1883 resided principally at Almora and Naini Tal. At Almora, the capital of the province of Kumaon, Dr. Watson had medical charge of the leper hospital for about ten years He had great opportunities, and gained great experience in connection with the treatment of this disease.

He was a man possessed of the greatest possible amount of bravery, and, while very retiring and modest in his disposition, he would at times narrate to intimate friends some of his experiences.

While stationed at Almora, the Medical Department of the Government of India gave instructions that the lepers were to be treated with gurjun oil, and that it was to be administered in doses to be taken internally, and also that the diseased portions of the lepers' bodies were to be anointed with this new supposed specific. Dr. Watson, with a deep sense of duty, endeavoured to carry out the instructions of the Government Department; but he soon found out that, while there was no great difficulty in getting the native medical assistants to administer the oil for internal purposes, the patients themselves were not quite so amenable, as the taste of the oil was objectionable and its effects were upsetting. The native assistants also declined point-blank to anoint the wounds of the lepers, and in many cases Dr. Watson had to do it himself at the great risk of inoculation. This treatment was carried on for about eighteen months, and, as the results were very far from satisfactory and the inconvenience to the patients very great, Dr. Watson reported so to the Department. All he got in reply was a letter expressing dissatisfaction that his efforts had obtained such a poor result, and re-

marking that he might have done better. No doubt, whoever wrote this epistle was little aware of the self-sacrifice of Dr. Watson, and how he risked his life in trying to carry out the instructions of his medical superiors. But however unpleasant such a communication may have been at the time, Dr. Watson used in later years to consider it a great joke and an evidence of the want of appreciation on the part of some uninformed official at headquarters.

Such censure as this, however, did not prevent his promotion, and he became Deputy Surgeon-General a considerable time before his retiral from the Service.

For further information refer to the Transactions of the Edinburgh Field Naturalists' and Microscopical Society, vol. vi, pt. v (1912): In Memoriam, William Watson, M.D., I.M.S., by Mr. John Lindsay, pp. 447–452.

SYMINGTON GRIEVE.

ROBERT CHAPMAN DAVIE.

Indirectly the war has robbed the Botanical Society of a member of its Council and a frequent contributor to its meetings in the person of Dr. R. C. Davie, Captain and Senior Chemist in the 4th Water Tank Company, R.A.M.C. The effects of an illness earlier in life precluded him from joining a combatant branch of service in the Great War, so he entered the Army in 1917 in a capacity in which his scientific education would find its full value. He served in France during the great push of 1918; but in January 1919 returned home on leave. He caught influenza on 27th January. Pneumonia followed, with rapid and fatal issue on 4th February. Thus terminates, at the age of 32, a life that was full of promise for the future; for in the short years given him Davie had already achieved much.

He was educated at the Glasgow High School, and passing on to the University of Glasgow, he graduated M.A. in 1907 with First Class Honours in English. His work in the Department of English Literature was such as would have justified his adopting some career in relation to it. But he had already taken the class of Elementary

Botany in 1905, as well as those in some other sciences; and a natural aptitude and taste for practical science held him. He took the B.Sc. degree in 1909, distinguishing himself particularly in Botany and Chemistry. But he decided upon the former as his life's work, and was promoted at once Junior Assistant in Botany in the University of Glasgow. Incidentally he had won the Dobbie-Smith Gold Medal, and held the Donaldson Research Scholarship.

While carrying out his departmental work with a cheerfulness and vigour that gave savour to its success, he entered at once on research. His first memoir was devoted to *Peranema* and *Diacalpe*, two genera of Eastern Ferns, which his observations have placed securely in their natural affinity. In 1912 he joined the staff of Professor Balfour in Edinburgh as assistant, and soon obtained promotion to the position of Lecturer, having special charge of the large classes for Teachers in Training. Meanwhile he was able to devote considerable time to research. He entered on a wide comparative investigation of the anatomy of the Pinna-Trace in Ferns, and he contributed two memoirs on this subject to the Transactions of the Royal Society of Edinburgh. His inquiry covered a large area of observation and was extended to the Cycads and Angiosperms. His results indicate that while in some degree the structure shown is related to immediate physiological needs, there is a substantial correspondence of detail with phyletic comparisons based on other characters. In fact, while the pinna-trace can be used as a subsidiary line of evidence, it cannot serve as a criterion of decisive importance in comparison. This was the most substantial contribution which he made to Botanical inquiry, and, together with his earlier papers, it provided his thesis for the Doctorate of Science in Glasgow, to which degree he was admitted in 1915.

Davie's investigations were, however, interrupted in 1914 by a journey to Brazil to collect materials for a comparison of certain Families of Flowering Plants. A grant was obtained from the Royal Society for this purpose. He travelled and collected in the neighbourhood of Rio and in the Organ Mountains. On his return, in the early days of the war, he first worked out his collections systemati-

cally; and he was already beginning the detailed comparisons when the insistent duty of military service came upon him. He qualified himself specially for the Water Service, and quickly rose to the rank of Captain in this responsible and necessary service He was present in France with his unit during the retreat of the earlier months of 1918, and the subsequent advance. After the armistice he was granted leave in January 1919, and died while at home.

Davie had already made his mark as a teacher, an investigator, and an organiser in Botany. An easy diction, with unusual command of his native tongue, gave him a good footing as a Lecturer. It is an open fact that he ran a strong candidature for a Chair in one of the larger Dominions in 1917, and early promotion to Professorial rank was anticipated for him. A quickness of apprehension of facts and comparisons, good powers of observation, a lively imagination, and a very retentive memory gave him a hold as an investigator, which a judgment ripening with age would have strengthened and directed into useful channels. As an organiser his departmental work was marked by cheerful efficiency. His stimulating influence was shown in the part he took in founding the Glasgow University Botanical Society. In a wider sphere his activity as one of the Secretaries of the Botanical Section of the British Association had already brought him in relation with the great body of British botanists. At the age of 32 he had fully qualified for years of active usefulness. It is this which makes his early death all the more lamentable. Time and opportunity were against him. So that at the moment of his death he was *of* the Front rather than actually *at* the Front, both in Science and in War.

F. O. Bower.

William Brack Boyd.

A past-president of the Society passed away on 16th March 1918 in the person of W. B. Boyd of Faldonside. He was born on 23rd February 1831 at Cherrytrees, Yetholm, and educated at The Grange, Sunderland.

He tenanted Hetton Hall, Northumberland, from 1859 to 1869, when he leased Ormiston in Roxburghshire; in 1881 he removed to Faldonside, which his wife had then inherited from an uncle. Living the quiet life of a country gentleman engaged in agricultural pursuits, he devoted much of his leisure to botanical studies and soon became known for his wide knowledge and successful cultivation of plants.

Elected a Fellow in 1871, he was President of our Society 1882–84, when he gave a Presidential address[1] on the Cultivation of Alpine and other Plants suited for the Rockery, and a Valedictory address[2] on the Study of Mosses.

Other societies also recognised his eminence as a botanist. He had twice been President of the Berwickshire Naturalists' Club, was President of the Scottish Alpine Club from 1891 till his death, and was also a Vice-President of the British Pteridological Society.

He is commemorated by having had two plants named in his honour, *Salix Boydii*, Linton, and *Sagina Boydii*, F. B. White.

A fuller account of this enthusiastic botanist will be found in the History of the Berwickshire Naturalists' Club, vol. xxiii, pt. iii, p. 423.

[1] Trans. Bot. Soc. Edin., xvi, p. 66

[2] Ibid., p. 181.

ROLL

OF

THE BOTANICAL SOCIETY OF EDINBURGH.

Corrected to October 1919

Patron.

HIS MOST GRACIOUS MAJESTY THE KING.

HONORARY FELLOWS.

BRITISH SUBJECTS (LIMITED TO SIX).

Date of Election.

Nov. 1896. BAKER, J. G., F.R.S., F.L.S., 3 *Cumberland Road, Kew*

Nov. 1888. DYER, SIR WILLIAM TURNER THISELTON, M.A., LL.D., K.C.M.G., C.I.E., F.R.S., *The Ferns, Witcombe, Gloucestershire.*

Dec. 1907. FARMER, J. BRETLAND, M.A., F.R.S., *Professor of Botany, Imperial College of Science and Technology, S. Kensington.*

Feb. 1911. MARSHALL, Rev. E. S., *West Monkton Rectory, Taunton.*

Feb. 1912. SCOTT, Dr. D. H., M.A., LL.D., Ph.D., F.R.S., *Oakley, Hants.*

FOREIGN (LIMITED TO TWENTY-FIVE).

June 1902. BONNIER, GASTON, *Professor of Botany, Paris*

June 1902. BRITTON, NATHANIEL LORD, *Director of the Botanic Garden, New York*

Feb. 1911. FLAHAULT, Dr. CHARLES, *Professor of Botany to the Faculty of Science, and Director of the Institute of the University, Montpellier.*

Mar. 1895. SARGENT, CHARLES S., *Professor of Arboriculture, and Director of the Arnold Arboretum, Harvard,—Corresponding Member, March* 1878.

June 1902. TIMIRJAZEW, Dr. K. A., *Professor of Botany, Moscow.*

June 1902. TRELEASE, Dr. WILLIAM, *University of Illinois, Urbana, Illinois, U.S.A.*

Mar. 1895. VRIES, Dr. H. DE, *Professor of Botany in the University, Amsterdam.*

June 1902. WALDHEIM, Dr. ALEXANDER FISCHER VON, *Professor of Botany and Director of the Imperial Botanic Garden, Petrograd.*

Dec. 1885. WARMING, Dr. EUGENE, For.M.L.S., *Emeritus Professor, Copenhagen.*

RESIDENT AND NON-RESIDENT FELLOWS.

No distinguishing mark is placed before the name of Resident Fellows who contribute annually and receive Publications.
* *Indicates Resident Fellows who have compounded for Annual Contribution and receive Publications.*
† *Indicates Non-Resident Fellows who have compounded for Publications.*
‡ *Indicates Non-Resident Fellows who do not receive Publications.*

Date of Election.

Dec. 1915. Adam, Robert Moyes, 17 *W. Brighton Crescent, Portobello.*
Feb. 1905. †Aiken, Rev. J. J. Marshall Lang, B.D., *The Manse, Ayton, Berwickshire.*
Nov. 1884. †Alexander, J. A., *Houghton, Rossmore Avenue, Parkstone, Dorset.*
Nov. 1914. Alexander, J. H., 8 *Chamberlain Road, Edinburgh.*
Mar. 1915. Alexander, Miss A. S. M., B.Sc., *High School, Stirling.*
Dec. 1913. Anderson, Thomas, M.A., B.Sc., 21 *Granby Road, Edinburgh.*
Dec. 1908. ‡Balfour, F. R. S., M.A., 39 *Phillimore Gardens, Kensington, London, W.*
May 1872. *Balfour, I. Bayley, Sc.D., M.D., F.R.S., F.L.S., *King's Botanist, Professor of Botany, and Keeper of the Royal Botanic Garden, Inverleith House.*
Dec. 1863. †Barnes, Henry, M.D., F.R.S.E., 6 *Portland Square, Carlisle.*
Jan. 1905. *Bell, A. C. M., W.S., *East Morningside House, Clinton Road.*
May 1891. *Berwick, Thomas, 56 *North Street, St. Andrews.*
Feb. 1919. †Blackburne, Cecil Ireland, *Valence, Westerham, Kent.*
May 1888. *Bonnar, William, 51 *Braid Avenue*
Jan. 1899. *Borthwick, A. W., O.B.E., D.Sc., 46 *George Square, Edinburgh.*
Dec. 1886. *Bower, F. O., M.A., D.Sc., F.R.S., F.L.S., *Professor of Botany, University of Glasgow,* 1 *St. John's Terrace, Hillhead, Glasgow.*
Feb. 1870. †Bramwell, John, M.D., "*The Hove,*" *Furze Hill Road, Torquay.*
April 1913. ‡Brebner, James, 2 *Scotswood Terrace, Dundee.*
Dec. 1906. †Bryce, George, B.Sc., *Botanic Garden, Peradeniya, Ceylon.*
Nov. 1894. Buchan-Hepburn, Bart., Sir A., *Smeaton Hepburn, Prestonkirk.*
Dec. 1915. Cadman, Miss Elsie, M.A., B.Sc., 30 *Trinity Road*
Feb. 1882. Caird, Francis M., M.B., C.M., F.R.C.S.Ed., *Professor of Clinical Surgery,* 13 *Charlotte Square,*—Artist.
Nov. 1905. Campbell, Robt., M.A., D.Sc., *Geological Department, University of Edinburgh.*
Dec. 1858. †Carruthers, William, F.R.S., F.L.S., *Central House, Central Hill, London, S.E.*
June 1873. *Clark, T. Bennet, C.A., *Newmills, Balerno.*
Dec. 1856. †Cleland, John, M.D., F.R.S., *Drumclog, Crewkerne, Somerset.*
May 1861. ‡Coldstream, Wm., B.A., I.C.S. (retd.), 69 *West Cromwell Road, London, S.W.*
April 1913. ‡Cooper, R. E., *c/o Secretary, Botanical Society of Edinburgh.*
Mar. 1900. *Cowan, Alexander, *Valleyfield, Penicuik.*
Feb. 1870. †Cowan, Charles W., *Dalhousie Castle, Midlothian.*
April 1909. Cowan, Robert Craig, *Eskhill, Musselburgh.*
Mar. 1903. Cowie, William Beaverley, F.C.S., 26 *Clyde Street.*
Dec. 1915. *Craib, W. G., M.A., *Royal Botanic Garden.*
Dec. 1866. *Craig, Wm., M.D., F.R.C.S.Ed., F.R.S.E., 71 *Bruntsfield Place.*
Dec. 1903. Davidson, J. Randolph, M.A., B.Sc., *School of Agriculture, Gizeh, Egypt.*
Dec. 1911. ‡Davidson, John, *Botanical Office, University of British Columbia, Vancouver, Canada.*
Dec. 1892. Day, T. Cuthbert, 36 *Hillside Crescent.*
April 1914. Dodd, A. Scott, B.Sc., 20 *Stafford Street, Edinburgh.*
Jan. 1894. *Dowell, Mrs. A., 13 *Palmerston Place, Edinburgh.*
Dec. 1911. †Drummond, J. R., B.A., F.L.S., F.Z.S., 119 *Twyford Avenue, North Acton, London, W.* 3.
Dec. 1859. †Duckworth, Sir Dyce, Bart., M.D., LL.D., 28 *Grosvenor Place, London, S.W.*
Dec. 1869. †Duthie, J. F., B.A., F.L.S., *c/o The Manager, Delhi & London Bank, Ltd.,* 5 *Bishopsgate, London, E.C.*
Feb. 1917. †Eley, Charles, *East Bergholt Place, Suffolk.*
Nov. 1885. Elliot, G. F. Scott, M.A., B.Sc., F.L.S., *Drumwhill, Mossdale.*
Jan. 1883. *Evans, Arthur H., M.A., 9 *Harvey Road, Cambridge.*
Dec. 1905. *Evans, Capt. W. Edgar, R.A.M.C., T.F., 38 *Morningside Park.*
Mar. 1890. Ewart, J. Cossar, M.D., F.R.SS. L. & E., *Professor of Natural History, University of Edinburgh.*

Date of Election.

Feb. 1894. Ferguson, Sir R. C. Munro, K.C.M.G., *of Raith and Novar, Kirkcaldy.*
Feb. 1873. *France, Charles S., 13 *Cairnfield Place, Aberdeen.*
Jan. 1906. *Fraser, James, 18 *Park Road, Leith.*
July 1872. *Fraser, John, M.B., C.M., 54 *Great King Street.*
Jan. 1903. Fraser, J. C., *Comely Bank Nurseries, Edinburgh.*
Mar. 1862. Fraser, Sir Thomas R., M.D., F.R.S., *Professor of Materia Medica, 13 Drumsheugh Gardens.*
Mar. 1871. *Gamble, James Sykes, M.A., F.L.S., *High Field, East Liss, Hants.*
May 1874. ‡Geikie, Sir Archibald, LL.D., F.R.SS. L. & E., *Shepherd's Down, Haslemere, Surrey.*
Jan. 1887. *Gibson, A. H., 28 *Dalhousie Terrace.*
May 1903. ‡Gilmore, Dr. Owen, L.R.C.P., L.R.C.S.E., 49 *Acre Lane, Brixton, London, S.W.*
Dec. 1907. Gourlay, Capt. W. Balfour, M.C., R.A.M.C., *2nd Lancashire Fusiliers, c/o G.P.O., London.*
Jan. 1889. *Grieve, James, *Redbraes Nurseries, Broughton Road.*
Dec. 1895. *Grieve, Sommerville, 21 *Queen's Crescent.*
Feb. 1879. *Grieve, Symington, 11 *Lauder Road.*
Nov. 1914. ‡Harley, Andrew, *Blinkbonny, Kirkcaldy.*
April 1910. Harvey, Miss Elsie, 5 *Salisbury Road.*
Jan. 1911. Hawick, Miss C. M., B.Sc., 10 *Derby Street, Leith.*
Mar. 1913. †Hayward, Miss Ida M., F.L.S., 7 *Abbotsford Road, Galashiels.*
April 1886. Hill, J. Rutherford, Ph.C., *Secretary, Pharmaceutical Society, 36 York Place.*
Feb. 1878. †Holmes, E. M., F.L.S., F.R.H.S., *Curator of Museum, Phar. Soc. of Great Britain, Ruthven, Sevenoaks, Kent.*
Feb. 1891. ‡Jamieson, Thomas, 10 *Belmont Street, Aberdeen.*
Dec. 1907. *Jeffrey, J. Frederick, *Redcroft, Redhill, Wrington, Somerset.*
Mar. 1905. †Joannides, Pericles, B.Sc., *Sporting Club, Ibrahimieh, Alexandria, Egypt.*
May 1877. *Johnston, Henry Halcro, C.B., D.Sc., M.D., F.L.S., *Colonel R.A.M.C., Orphir House, Orphir, Kirkwall.*
Dec. 1912. *Johnstone, James Todd, M.A., B.Sc., *Royal Botanic Garden, Edinburgh.*
Jan. 1874. *Kirk, Robert, M.D., F.R.C.S.Ed., *Bathgate.*
Dec. 1911. *Lamont, Miss Augusta, B.Sc., 73 *Falcon Road.*
Jan. 1914. Latimer, Sydney, 2 *Hermitage Gardens, Edinburgh.*
Dec. 1917. Law, Mrs. John, 41 *Heriot Row, Edinburgh.*
Feb. 1888. ‡Learmonth, Wm., *Fleetview, Gatehouse of Fleet.*
Feb. 1878. ‡Lennox, David, M.D., F.C.S., *Tayside House, Nethergate, Dundee.*
Jan. 1895. MacDougall, R. Stewart, M.A., D.Sc., 9 *Dryden Place.*
Jan. 1881. †Macfarlane, John M., Sc.D., F.R.S.E., *Professor of Botany, University of Philadelphia, U.S.A.*
Feb. 1886. M'Glashan, D., 11 *Corrennie Gardens.*
June 1880. *M'Intosh, W. C., M.D., LL.D., F.R.SS. L. & E., F.L.S., 2 *Abbotsford Crescent, St. Andrews.*
Feb. 1911. Macpherson, Alexander, M.A., B.Sc., 5 *London Street, Edinburgh.*
June 1897. †Macvicar, Symers M., *Invermoidart, Acharacle, Argyllshire.*
Feb. 1914. Macwatt, John, M.B., C.M., *Morelands, Duns.*
Oct. 1914. *Martin, Isa, M.A., 1 *Hampton Place, Edinburgh.*
Jan. 1902. Massie, William Hall, *Redbraes House, Broughton Road.*
Mar. 1913. †Matthews, James R., M.A., *Birbeck College, Breams Buildings, London, E.C.*
Feb. 1902. *Millar, R. C., C.A., 6 *Regent Terrace,*—Auditor.
April 1919. ‡Mills, Albert Edward, 8 *George Street, Bath.*
Jan. 1899. Morton, Alex., B.Sc., 23 *Morningside Grove.*
July 1878. †Muirhead, George, F.R.S.E., *Gordon Estates Office, Fochabers.*
Oct. 1918. †Murray, J. M., B.Sc., *Kingswood, Murthly, Perthshire.*
April 1916. †Nicholson, C., Esq., F.E.S., 35 *The Avenue, Hale End, Chingford, Essex.*
Dec. 1907. *Orr, Matt. Y., *Royal Botanic Garden, Edinburgh.*
Oct. 1914. †Patton, Donald, M.A., B.Sc., *Manse Villa, Pollok Road, Shawlands, Glasgow.*
April 1883. *Paul, Very Rev. David, M.A., LL.D., D.D., *Carridale, Fountainhall Road,*—Foreign Secretary.
April 1887. Peyton, Rev. W. W., *Braeriach, Tan-y-Bryn Road, Llandudno, Wales.*
Dec. 1917. Pike, J. Lyford, B.Sc., *Rosetta, Liberton.*

Date of Election.

Jan. 1915. Pinkerton, A. A., 19 *Shandwick Place, Edinburgh.*
June 1891. †Prain, Sir David, M.D., C.I.E., F.R.SS. L. & E., F.L.S., *Royal Botanic Gardens, Kew.*
July 1884. *Rattray, John, M.A., B.Sc., F.R.S.E., *Tullyburn Terrace, Glasgow Road, Perth.*
April 1877. ‡Riddell, Wm. R., B.A., B.Sc., (*Hon. Mr. Justice*), *Osgoode Hall, Toronto, Canada.*
Dec. 1869. *Robertson, A. Milne, M.B., C.M., *Hawea, Rodway Road, Roehampton, London, S.W.*
Dec. 1890. Robertson, Robert A., M.A., B.Sc., *Lecturer on Botany, Botanical Department, Bute Medical School, St. Andrews.*
Feb. 1905. *Ross, A. J., M.A., B.Sc., *Schoolhouse, Gretna.*
June 1898. Russell, David, *Rothes, Markinch.*
Mar. 1902. Sampson, Hugh C., B Sc , *Trichinopoly, Madras, India.*
Dec. 1887. ‡Scott, J. S., L.S.A., 69 *Cloues Street, West Gorton, Manchester.*
Feb. 1891. *Smith, J. Pentland, M.A., B.Sc , *Braedene, Lochwinnoch, Renfrewshire.*
Nov. 1914. Smith, James L. S., M.A , B Sc., 17 *Cargill Terrace, Trinity.*
Dec. 1917. †Smith, J. T., 68 *Tennant Street, Glasgow.*
Dec. 1909. Smith, Wm. G., B.Sc., Ph D , 9 *Braidburn Crescent.*
Jan. 1902. *Smith, W. W , M.A , *Royal Botanic Garden, Edinburgh* (6 *Lennox Row, Leith*),—HONORARY SECRETARY
Jan. 1890. *Somerville, William, Œc.D., B.Sc., F.R.S.E., *Sibthorpian Professor of Rural Economy*, 121 *Banbury Road, Oxford.*
Oct. 1914. †Stewart, Edward J. A., M A , B.Sc., 8 *Manor Road, Jordanhill, Glasgow.*
Oct. 1918. †Stewart, Capt. William, *Shambellie, Kirkcudbright.*
Dec. 1916. †Stirling-Maxwell, Sir John, Bart , *Pollok, Pollokshaws, Glasgow.*
Feb. 1902. Tagg, Harry F., F.L S , *Royal Botanic Garden, Edinburgh.*
Jan. 1913. ‡Tagg, M. H., 53 *Clayton Avenue, Wembley, Middlesex.*
Dec. 1887. Terras, J. A., B Sc , 40 *Findhorn Place.*
Jan. 1909. Thompson, Miss Jean G , B Sc , 19 *Pentland Terrace.*
Dec. 1888. Turnbull, Robert, B Sc , *Board of Agriculture*, 4 *Upper Merrion Street, Dublin.*
July 1886. †Waddell, Alexander, *of Palace, Jedburgh.*
Oct. 1918. †Watson, Harry, *Forestry School, Dunkeld*
Feb. 1901. Whytock, James, *Dalkeith Gardens, Dalkeith*
Dec. 1890. *Wilson, John H , D Sc , F.R S E , 39 *South Street, St. Andrews* :—*Associate, Nov.* 1886
Feb. 1912. Wilson, Malcolm, D.Sc , 31 *Wardie Road, Trinity.*
Mar. 1909. *Wilson, Thos , Ph.C , 110 *High Street, Burntisland.*
May 1873. ‡Wright, R. Ramsay, M A , B Sc , *Professor of Natural History, University, Toronto*
May 1863. †Yellowlees, David, M D , LL D , 6 *Albert Gate, Dowanhill, Glasgow.*
Jan. 1903. Young, William, *Fairview, Kirkcaldy.*

ORDINARY MEMBERS.

Nov. 1910. Clark, Mrs. Bennett, *Newmills, Balerno.*
Nov. 1910. Grieve, Miss Jean E., 11 *Lauder Road, Edinburgh.*

ASSOCIATES.

Mar. 1886. Bennett, A., F.L.S., 5 *Thanet Place, High Street, Croydon.*
Feb. 1871. Evans, William, F.R.S.E., 38 *Morningside Park.*
Jan. 1906. Harrow, R. L., *Royal Botanic Garden, Edinburgh.*
Feb. 1919. Johnson, Norman M , B.Sc , 17 *Douglas Street, Kirkcaldy.*
Dec. 1863. Richardson, Adam D., 19 *Joppa Road, Portobello, Midlothian.*
Jan. 1906. Stewart, L. B., 23 *Brandon Terrace.*

LADY MEMBERS.

June 1893. Aitken, Mrs. A. P., 15 *Victoria Mansions, West Hampstead, London, N.W.*
April 1893. Balfour, Mrs. Bayley, *Inverleith House.*
Feb. 1910. Galletly, Mrs. Sarah H., 71 *Braid Avenue.*
April 1902. Grieve, Mrs. Symington, 11 *Lauder Road.*

CORRESPONDING MEMBERS.

Date of Election.

Dec. 1905. Adamovic, Lujo, *Professor of Botany, and Director of the Botanic Garden, Belgrade.*

Dec. 1905. Barboza, J. Casimiro, *Director of the Botanic Garden, Oporto.*

Dec. 1905. Beijerinck, M. W., *Professor of Bacteriology, Delft.*

Dec. 1881. Bohnensieg, Dr. G. C. W., *Conservator of the Library of the Museum Teyler, Haarlem.*

Mar. 1881. Caminhoá, Dr. Joaquim Monteira, *Rio de Janeiro.*

Dec. 1905. Campbell, Dr. Douglas Houghton, *Professor of Botany, Stanford University, California.*

July 1879. Cheeseman, T. F., F.L.S., F.Z.S., *Curator of the Museum, Auckland, New Zealand.*

July 1879. Cleave, Rev. W. O, LL.D., *College House, St Helier, Jersey.*

Dec. 1905. Cockayne, L, Ph.D., F.R.S, 20 *Colombo Street, Wellington, New Zealand.*

June 1902. Constantin, Dr. J., *Director, Jardin des Plantes, Paris.*

Dec. 1905. Coulter, John Merle, *Professor of Botany, University of Chicago.*

June 1902. Cramer, Dr. Carl Eduard, *Professor of Botany, Zurich*

Mar. 1895. Elfving, Dr. Fredrik, *Professor of Botany in the University, and Director of the Botanic Garden, Helsingfors.*

Dec 1905. Famintzin, Dr André, *Emeritus Professor of Botany, and Director of the Botanical Laboratory of the Imperial Academy of Sciences, Petrograd.*

Dec. 1905. Fawcett, William, B.Sc., F.L S, 76 *Shooter's Hill Road, Blackheath, London, S.E*

Dec. 1905. Gravis, Auguste, *Professor at the University, and Director of the Botanic Garden, Liège.*

Mar. 1895. Guignard, Léon, Membre de Institut, *Professor of Botany, Paris.*

June 1902. Henriques Julio A., *Professor of Botany in the University, and Director of the Botanic Garden, Coimbra*

May 1891. Henry, Augustine., M D, *Professor of Forestry, Royal College of Science, Dublin*

Dec. 1905. Kjellman, Dr Frans, *Professor of Botany in the University, and Director of the Botanic Garden, Upsala*

June 1902. MacMillan, Conway, *Minnesota*

Dec. 1905. Macoun, John, M A., F.L S, *Dominion Botanist on the Geological Survey, Ottawa.*

June 1902. Maiden, J. H, J P, F R.S., *Director of the Botanic Garden, Sydney, N S W*

Dec. 1905. Mattirolo, Dr. Oreste, *Professor of Botany in the University, and Director of the Botanic Garden, Torino, Piedmont.*

Dec. 1905. Miyabe, Dr. Kingo, *Professor of Botany, Hokkaido Imperial University, and Director of the Botanic Garden, Sapporo, Hokkaido, Japan*

June 1902. Miyoshi, Manabu, *Professor of Botany in the Imperial University, Tokio.*

June 1902. Raunkiar, Christen, *Assistant in the Botanic Garden, Copenhagen.*

Dec. 1905. Rodway, Leonard, C M G., *Government Botanist of Tasmania, Hobart*

Dec. 1905. Schröter, Dr. Carl, *Professor of Botany, and Director of the Botanical Museum, Zürich.*

Nov. 1888. Sully, W. C., *Cape Town.*

May 1876. Terracciano, Dr. Nicolao, *Director of the Royal Gardens, Caserta, Campania.*

Nov. 1888. Tyson, W., *Cape Town.*

Dec. 1905. Vladescu, Dr. Mihail, *Professor of Botany at the University, and Director of the Botanic Garden, Bukarest.*

Dec. 1887. Wildpret, H., *Director of the Botanic Garden, Orotava.*

June 1902. Wille, Dr. Johan Nordal Fischer, *Professor in the University, and Director of the Botanic Garden, Christiania.*

THE SOCIETY EXCHANGES PUBLICATIONS WITH—

AMERICA.

CANADA.

Disko, Greenland,	Den Danske Arktiske Station.
Halifax,	Department of Agriculture.
	Nova Scotian Institute of Natural Science.
Montreal,	Natural History Society.
Ottawa,	Geological Survey of Canada.
	Central Experiment Farm.
Toronto,	Canadian Institute.

COSTA RICA.

San José,	Instituto Nacional.

MEXICO.

Escuintla, Chiapas,	Director, La Zacualpa Botanical Station.

UNITED STATES.

Ann Arbor, Michigan,	University of Michigan.
Berkeley, Calif.,	University of California.
Boston, Mass.,	Massachusetts Horticultural Society.
	Society of Natural History.
Cambridge, Mass.,	Gray Herbarium, Harvard University.
Cincinnati, Ohio,	Society of Natural History.
	Lloyd Botanical Library.
Colorado Springs, Col.	Colorado College.
Columbia, Mo.,	Library of University of Missouri.
Columbus, Ohio,	Ohio State University.
Davenport, Iowa,	Academy of Natural Sciences.
Indianapolis,	Indiana Academy of Sciences.
Ithaca, N.Y.,	Cornell University.
Madison, Wis.,	Wisconsin Academy of Sciences.
Manhattan, Kansas,	State Agricultural College.
Milwaukee, Wis.,	Public Museum of Milwaukee.
Minneapolis, Minn.,	Botanical Department, University of Minnesota.
New Haven, Conn.,	Academy of Arts and Sciences.
New York,	Academy of Sciences.
	American Museum of Natural History.
	Torrey Botanical Club.
Philadelphia,	Academy of Natural Sciences.
	University of Pennsylvania.
Rochester, N.Y.,	Rochester Academy of Sciences.
St. Louis, Missouri,	Botanic Garden.
San Francisco, Calif.,	California Academy of Sciences.

Lawrence, Kansas,	Academy of Science.
Urbana, Ill., . .	University of Illinois.
Washington, . .	National Academy of Sciences.
	United States Geological Survey.
	Smithsonian Institution.
	United States Department of Agriculture; National Herbarium; Office of Experiment Stations.

South America.

Bogota, Rep. of Colombia,	Ministry of Public Works.
La Plata, . . .	Museo de La Plata, Rep. Argentina.
Monte Video, . .	Museo Naçional de Monte Video.
Rio de Janeiro, .	Museo Naçional.

WEST INDIES.

Jamaica	Botanical Department.
Trinidad, . . .	Royal Botanic Garden.

AFRICA.

Cape Town, . .	Government Herbarium.
Durban, ...	Natal Herbarium.

ASIA.

Calcutta, . . .	Indian Museum.
	Royal Botanic Garden.
Ceylon, ...	Royal Botanic Garden, Peradeniya.
Manila, ...	Bureau of Science.
Straits Settlements,	Botanic Gardens.
Buitenzorg, . . .	Botanic Garden.
Tokio, ...	Imperial University College of Agriculture.

AUSTRALASIA.

New South Wales.

Sydney, ...	Department of Agriculture.
	Royal Society of New South Wales.

New Zealand.

Wellington, . . .	New Zealand Institute.

Queensland.

Brisbane, . . .	Department of Agriculture.
	Royal Society of Queensland.

West Australia.

Perth, ...	Department of Agriculture.

TASMANIA.

Hobart, ... Royal Society of Tasmania.

VICTORIA.

Melbourne, . . . Department of Agriculture.
National Herbarium.
Royal Society of Victoria.

EUROPE.

BELGIUM.

Brussels, . . . Académie Royale des Sciences, des Lettres, et des Beaux-Arts de Belgique.
Institut Botanique Léo Errera, Bruxelles.
Société Royale de Botanique de Belgique.
Liège, ... Botanic Garden.

DENMARK.

Copenhagen, . . Botaniske Forening

FRANCE.

Amiens, ... Société Linnéenne du Nord de la France.
Cherbourg, . . . Société Nationale des Sciences Naturelles et Mathématiques.
Lyons, ... Société Botanique.
Marseille, . . Faculté des Sciences de Marseille.
Paris, ... Société Botanique de France.

GREAT BRITAIN AND IRELAND.

Alnwick, . . . Berwickshire Naturalists' Club.
Belfast, ... Natural History and Philosophical Society.
Bristol, ... Bristol Naturalists' Society.
Cambridge, . . Philosophical Society.
Cardiff, . . . Naturalists' Society.
Dublin, . . . Royal Dublin Society.
Edinburgh, . . . Royal Scottish Arboricultural Society
Edinburgh Geological Society.
Royal Society of Edinburgh.
Royal Scottish Geographical Society
Royal Scottish Society of Arts.
University of Edinburgh.
Glasgow, ... Natural History Society.
Royal Philosophical Society.
University of Glasgow.
Huddersfield, . . Yorkshire Naturalists' Union.
Liverpool, . . Botanical Society.
London, ... Board of Agriculture.
Editor of *Gardeners' Chronicle*.
Linnean Society.
Editor of *Nature*.
Quekett Microscopical Club.
Royal Gardens, Kew.
The Royal Society.
Royal Horticultural Society.
Royal Microscopical Society.

Manchester, . .	Manchester Literary and Philosophical Society.
Millport, . . .	Marine Biological Association.
Newcastle-upon-Tyne,	Durham Philosophical Society.
	Natural History Society of Northumberland, Durham, and Newcastle-on-Tyne, and the Tyneside Naturalists' Field Club.
Norwich, . . .	Norfolk and Norwich Naturalists' Society.
Perth, . . .	Perthshire Society of Natural Science.
Plymouth, . . .	Plymouth Institution.
Stratford, .	Essex Field Club.
Watford, . . .	Hertfordshire Natural History Society and Field Club.

HOLLAND.

Amsterdam, .	Koninklijke Akademie van Wettenschappen.
Haarlem, . .	Koloniaal Museum.
	Musée Teyler.
Leiden, ...	Rijks Herbarium.
Luxembourg,	Société Botanique du Grand-duché de Luxembourg.

ITALY.

Florence, . . .	Soc. Botanico Italiano.
Rome, . . .	Regio Istituto Botanico.
Catania, Sicily,	Orto Botanico d'Universita.

PORTUGAL.

Lisbon, ...	Academia das Sciencias.

ROUMANIA.

Bukarest . .	Institut Botanique.

RUSSIA.

Helsingfors, . .	Societas pro Fauna et Flora Fennica.
Kieff, . .	Société des Naturalistes.
Moscow, . .	Société impériale des Naturalistes.
Petrograd, . .	Hortus botanicus imperialis.
	Musée Botanique de l'Académie impériale des Sciences.

SCANDINAVIA.

Lund, ...	Universitas Lundensis.
Stockholm, . . .	Kongl. Svenska Vetenkaps Akademien.
	Svenska Botaniska Foreningen.
Upsala, . . .	Kungl. Vetenskaps Societeten.

SWITZERLAND.

Berne, ...	Naturforschende Gesellschaft.
Geneva, ...	Conservatoire et Jardin Botaniques.
Zürich, ...	Naturforschende Gesellschaft.

INDEX.

Adam, J. C., v, xv, 123.
Ambleside District of Westmoreland, Vegetation of, xiv.
Anderson, T., xiv.
Araujia sericifera, xv.
Argyresthia atmariella, v.
Balfour, Professor Bayley, x, xv, xix, 65, 79, 97, 157, 221, 231, 246, 273.
Beesia, iii.
Ben Ledi, Vegetation of, iv.
Bennett, Arthur, 54, 104, 134, 135, 305, 309, 312, 315.
Biltia Vaseyi, xix.
Borthwick, Dr. A. W., vi, xii, xiv, xviii, xix.
Boyd, W. B., iii, xv.
——— Obituary notice of, 344.
Brown, Richard, xv.
Buchan-Hepburn, Sir Archibald, vii.
Bulbophyllum Imogeniae, a new orchid from Nigeria, 228.
Burseraceae, Resin Ducts in Wood of, vii.
Caithness, Notes on the Flora of, 309.
Calamagrostis stricta, 305.
——— *strigosa*, 307.
Callidium violaceum, x.
Calluna vulgaris, v.
Cannock Chase, *Vaccinium intermedium* from, 327.
Cavea: a New Genus of Compositae, 119.
Cavea tanguensis, 120.
Ceratophyllum demersum in the Orkney Isles, 134.
Chermes piceae, iii.
Chester, George, xvii.
Clark, T. Bennet, vii.
Clathrus cancellatus in Argyllshire, 301.
Clavaria aurea, 302.
——— *botrytis*, 302.
Corallorhiza innata, 136.
Crawford, W. C., xv.
Crossman, Mrs. M., iv.
Cryptorrynchus lapathi, xviii.
Davie, Dr. R. C., iv.
——— Obituary Notice of, 342.
Dracocephalums from China, New Garden, 89.
Dracocephalum Forrestii, 90.
——— *Isabellae*, 89.
Dracocephalum propinquum, 92.
——— *taliense*, 93.
——— *tanguticum*, 91.
Dragon Tree, xviii.
Duckworth, Sir Dyce, xviii, xix.
Edinburgh, Moss Records for, 149.
Ernobius mollis, vi.
Evans, William, 136, 138.
Fraser, James, iii, 302.
Forest Survey, xviii.
Forrest, George, vii, ix, 89.
Fritillaria flavida, 284, 291, 299.
——— *lophophora*, 284, 291, 298.
——— *oxypetala*, 284, 291, 299.
——— *Stracheyi*, 284, 291, 299.
Fumaria Bastardi, iii.
——— *purpurea*, iii.
Gentiana Farreri, 248, 260, 271.
——— *Lawrencei*, 250, 260, 271.
——— *ornata*, 261, 264, 271.
——— ——— var. *acutifolia*, 271.
——— ——— var. *obtusifolia*, 271.
——— *prolata*, 266, 271.
——— *sino-ornata*, 253, 260, 271.
——— *Veitchiorum*, 257, 260, 271.
Gentians, Some Late-flowering, 246.
Ginger-beer plant, xvii.
Glenshee, Flora of, xiv.
Gourlay, Capt. W. Balfour, 327.
Grieve, Symington, x, xvi.
Haddington, Moss Records for, 145.
Hagström's Critical Researches on Potamogeton, 1916, 315.
Hamilton, Kenneth, 228.
Hill, J. Rutherford, xvii.
Histology of Gymnosperm Cuttings, ii.
Histology of Roots, The Influence of Different Media on, 74.
Hylesinus crenatus, v.
Insect Visitors to *Corallorhiza innata*, etc., 136.
Johnson, N. M., xiv.
Koeleria advena, 302.
Law, Mrs., xvii.
MacDougall, Col., xix.
MacDougall, Dr. R. Stewart, ii, v, xviii, 334.
M'Glashan, D., xvi.
Mason, Andrew, xviii.
Megastigmus strobilobius, ii.
Melampsora alpina, xx.

Melampsora Orchidi-repentis, iv.
Melilotus arvensis, xvi.
Merodon equestris, v.
Monstera deliciosa, 76.
Moss Records for Selkirk, Peebles, and the Lothians, 138.
Mosses from West Lothian, 123.
Mosses from West Ross-shire, vi.
Moulds, Artificial Cultures of, 335.
Murray, J. M., iii.
Myelophilus minor, Scottish Records of, 334.
New Associate—
Johnson, N. M., xviii.
New Fellows—
Adam, R. M., iv.
Blackburne, C. I., xviii.
Cadman, Miss Elsie, iv.
Craib, W. G., iv.
Eley, Charles, ix.
Law, Mrs. John, xiv.
M'Pherson, Miss Beatrice Campbell, v.
Mills, A. E., xviii.
Murray, J. M., xv.
Nicholson, Charles, v.
Pike, J. Lyford, xiv.
Smith, J. T., xiv.
Stewart, Capt. William, xv.
Stirling-Maxwell, Sir John, Bart., ix.
Watson, Harry, xv.
Nicholson, Charles, vi, x.
Nomocharis, The Genus, 273.
Nomocharis Forrestii, 293.
——— *leucantha*, 276, 291.
——— *Mairei*, 280, 281, 291.
——— *meleagrina*, 278, 291.
——— *pardanthina*, 274, 275, 291.
——— *saluenensis*, 294.
——— *tricolor*, 296.
——— *Wardii*, 297.
Norman, Capt., xv.
Oliver, Daniel, ix.
Orkney Isles, Notes on the Flora of, 54.
Parasyringa, a New Genus of Oleaceae, 93.
Parasyringa sempervirens, 95.
Paul, Very Rev. David, D.D., LL.D., 301.
Peebles, Moss Records for, 141.
Periodicity in Transpiration, 59.
Petasites fragrans, xvii.
Phytolacca, New, xiv.
Pike, J. Lyford, ii, vi.
Pine Forest of Ravenna, xix.
Plantago lanceolata, xvi.
Polystachya Hamiltonii, 229.
Potamogeton alpinus, 104.
——— *crispus*, 104.
——— *crispus* × *alpinus*, 104.
——— *decipiens*, 104.
——— *venustus* ×, 104.
Potamogeton longifolius, Gay, in England, 312.
Potamogetons in the Canal at Market Harboro', Leicestershire, xvii.
Praeger, R. Lloyd, 107.
Presidential Address, 1917–18, xvii.
Primula chrysopa, 231.
——— *Harroviana*, 233.
——— *Hopeana*, 236.
——— *Maclareni*, 238.
——— *rupestris*, 240.
——— *scopulorum*, 243.
Puccinia borealis, xix.
——— *septentrionalis*, xix.
Resin Ducts in the Medullary Rays of the Wood of Species of Burseraceae, vii.
Rhododendron adenogynum, 222.
——— *adenostemonum*, 174.
——— *agastum*, 178.
——— *anthopogon*, 225.
——— *anthosphaerum*, 181.
——— *araiophyllum*, 184.
——— *arboreum*, 223.
——— *argenteum*, 223.
——— *bullatum*, 223.
——— *campanulatum*, 223.
——— *ceraceum*, 187.
——— *Clementinae*, 223.
——— *dichroanthum*, 223.
——— *eriogynum*, 220.
——— *eritimum*, 190.
——— *facetum*, 220.
——— *Falconeri*, 224.
——— *fictolacteum*, 103, 224.
——— *gymnanthum*, 192.
——— *haematodes*, 224.
——— *Hodgsoni*, 224.
——— *hylothreptum*, 195.
——— *irroratum*, 199.
——— *japonicum*, x.
——— *Kendrickii*, 220.
——— *lacteum*, 97, 224.
——— ——— var. *macrophyllum*, 98.
——— *lukiangense*, 203.
——— *mekongense*, 79, 80, 82.
——— *melinanthum*, 79, 80, 85.
——— *mengtszense*, 206.
——— *niphargum*, 224.
——— *pogonostylum*, 210.
——— *Roxieanum*, 224.
——— *sanguineum*, 99.
——— *sinogrande*, 224.
——— *spanotrichum*, 214.
——— *taliense*, 224.
——— *tanastylum*, 217.
——— *trichocladum*, 79, 80, 84.
——— *xanthinum*, 79, 80, 87.
Rhododendron Flora, Statistics of the Chinese, x.
Rhododendron Seedlings, Observations on, 221.
Rhododendrons of the Irroratum Series, 157.
Rhynchanthus, New, xiv.
Robertson, R. A., xiv.
Saussurea tanguensis, 120.
Saxifraga aculeata, 69, 70.
——— *cortusaefolia*, 67, 68, 74.
——— *cuscutaeformis*, 65, 67.
——— *dumetorum*, 71.
——— *flabellifolia*, 69.
——— *Fortunei*, 67, 68.
——— *geifolia*, 69, 72.
——— *Henryi*, 65, 69, 72.
——— *imperialis*, 69, 73.

Saxifraga madida, 67, 68.
——— *rufescens*, 67, 68, 74
——— *sarmentosa*, 65, 66, 67, 68, 70.
——— *sendaica*, 69
——— *Veitchiana*, 65, 67, 68, 70, 75
Saxifrages of the Diptera Section, 65
Scott, Miss F B , ii
Sedum Praegerianum, On the Affinities of, with a Tentative Classification of the Section Rhodiola, 107
Seed-testing, Principles of, xiv.
Selkirk, Moss Records for, 139, 156
Sino-Himalayan Flora, 13
Sirex gigas, ii
Small, James, 119
Smith, Dr W G , iv, v, xiv
——— W W , iii, vii, xiv, 89, 93, 119, 338
Stirton, Dr. James, vi
Syringa sempervirens, 95
Tagg, Harry F , vii, xviii, xix, xx, 335
Tobacco, German War, xix.
Trailliaedoxa, vii
Transpiration, Periodicity in, 59.
Trypodendron domesticum, v.
Ulex nanus, in Caithness, 185.
Vaccinium intermedium, 327
Ward, F Kingdon, 1, 13
Watson, Dr William, Obituary Notice of, 339
West Lothian, Mosses from, 123.
Whytock, James, xviii
Whytockia, a New Genus of Gesneraceae, 338
——— *chiritaeflora*, 338.
——— ——— var *minor*, 338.
Wilkie, Miss Sophie J , 59, 76
Wilkinson, W H , xv
Wilson, Dr Malcolm, xix
Young, William, xiv
Yunnan, Some Plant Associations of, 1

PRINTED IN GREAT BRITAIN BY NEILL AND CO., LTD , EDINBURGH.

Date of issue	Date of issue	Date of issue